Everyday Scientists: High School Poets, Home Brewers, and Scuba Divers

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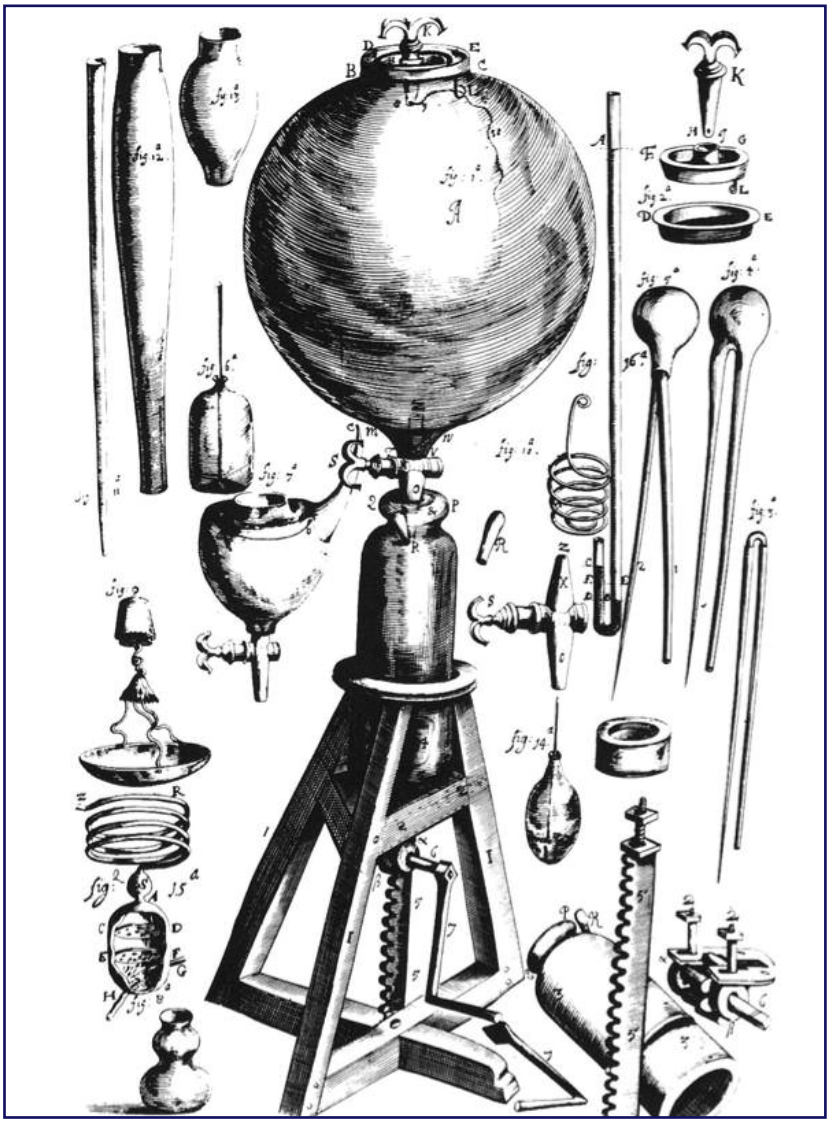
Remember when we were all new scuba diving students; we were introduced to the intangible and obscure world of gases? We learned (or re-learned) the stuff of high school physical science classes. The déjà vu of those old adolescent years in science class was not necessarily welcomed by all—but nonetheless, rediscovering those basic lessons helped us understand how our bodies and equipment react to being underwater. Think about it: in what other recreational activity are you asked to learn about gas laws? And then even worse, you get tested on it? Beer making—maybe. All brewers know a good bit about gasses and pressure. And in their case, the test is whether or not their bottles explode.

Theories and lessons about gases—and other things we cannot see—are not exactly easy to comprehend. A high school teacher in Columbus, Georgia, has students each write a poem about what they've learned about gases. Here are a few clever excerpts from the poem by a former student, Ahmad Hernandez:



Drawing of Robert Boyle's air pump. From Wikimedia Commons.

The Ballad of a Gas

Oh, teeny-weeny molecule,
A diatomic gas,
you have a lot of qualities
that always, always last.

The pressure that you're always in
can change the way you act.
If it goes down, your volume grows,
I can tell you it's a fact.

The temperature that you reside
is very similar.
But as you cool, your volume shrinks,
You shiver, and say, "Brrr!"
Oh, little gaseous molecule,
I love you through and through;
but my heart breaks, and how it aches
When someone smells like you.

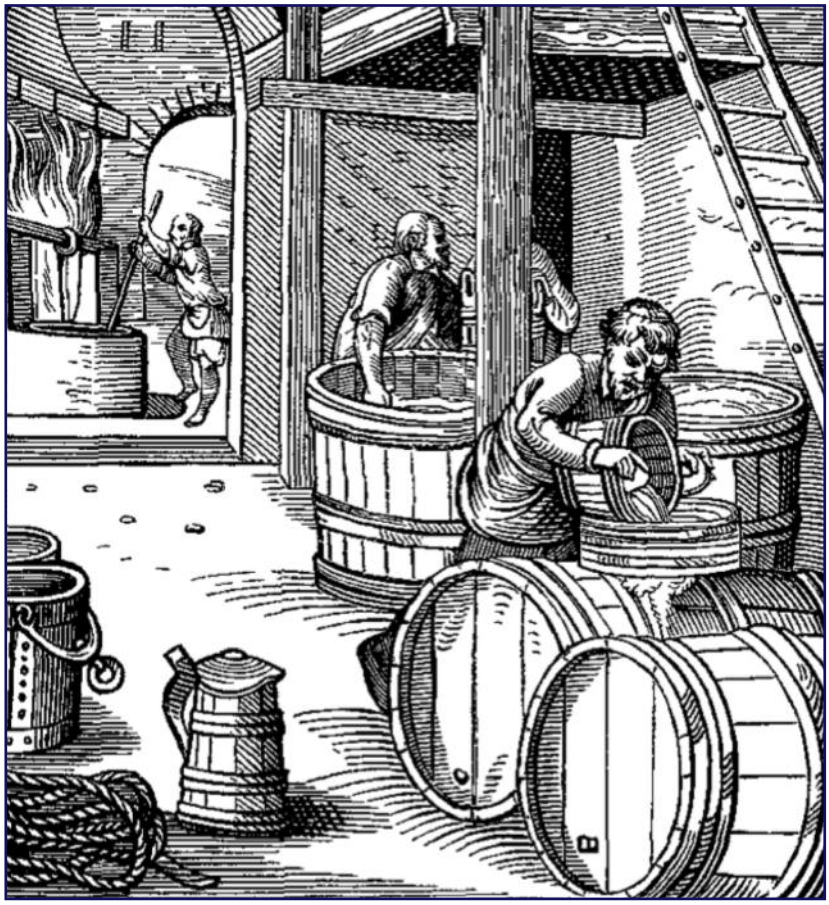
I have a feeling the creative and talented Ahmad can still remember a bit about gases and their curious behavior. For the rest of us, this is nearly impossible unless you use knowledge about gases in your daily lives (or write clever poetry about them). I'm an oceanographer who studies carbon dioxide

(CO_2) in the ocean, so I think about gases all the time—but we as divers do too, every time we dive.

Our basic understanding of the properties of gases has been understood for centuries. In the 17th century, Galileo discovered that air had weight, and the measurement of atmospheric pressure was born. Newer developments of gas laws of the 18th century told us, among other things, about the solubility of gases in liquids: critical to the development of our dive tables.

What makes teaching diving exciting to me—besides sharing the wonder of the underwater world—is that scuba diving provides a tangible context for applying science in the real world. Unless you're someone like Ahmad, I wouldn't expect that many people remember the properties of gases learned in high school. Yet scuba divers retain that kind of information because they apply it. And this makes divers better equipped to understand a whole set of other complex issues, such as the issue of CO_2 in our atmosphere and how it affects our oceans.

Scientists have understood the basic properties of CO_2 gas for many years. We learned centuries ago that CO_2 was a greenhouse gas—in other words, it traps heat from the sun. And about a century ago, we learned that increasing CO_2 from manmade sources might account for long-term trends in the Earth's temperature. Humans are now releasing approximately nine billion tons of carbon into the atmosphere each year, certainly an incredibly abstract concept to nearly everyone. But as divers we understand that air has weight—think of an empty scuba cylinder and how much easier it is to move around than a full one! Divers also know about gas exchange, mostly in the context of gas exchange in the lungs and diffusion into the bloodstream. So it is not a stretch to realize that gas exchange occurs at the atmosphere-ocean interface, and as CO_2 continues to increase in the atmosphere, CO_2 will continue to dissolve in the ocean.



A 16th century brewery. From Wikimedia Commons.

This is why I love science: a little bit of knowledge touches so many parts of our lives and helps us to understand the complex world we live in. And diving makes us into scientists.

Many of us scuba scientists are concerned about an issue related to manmade CO_2—ocean acidification. As the concentration of CO_2 increases in the atmosphere, the surface ocean seeks to remain at equilibrium by absorbing about a quarter of this human-emitted CO_2 every year. When CO_2 dissolves in the ocean, it shifts the acid-base chemistry of seawater and leads to a decrease in pH and a concentration of carbonate ions.

This is a concern, especially for organisms like coral, which need carbonate to build calcium carbonate shells and skeletons. New research shows that in coral reefs where "natural ocean acidification" occurs—meaning reefs near volcanic seeps that cause CO_2 to bubble through the seafloor—biodiversity and structural complexity are greatly reduced. This research shows us what the future of coral reefs may be if CO_2 emissions continue unabated.

As divers, we are closer to and understand these issues more than most. Not only because we care about the health of the underwater world but because we all have advanced knowledge of the physics of gases! And so do our scuba students. Arming them with the information and science to be stewards of the ocean keeps them curious, keeps them informed, and maybe even spins those daunting old high school memories of science class into a new and refreshing light.