WESTERN SCIENCE SPEAKS PODCAST
SEASON 3, EPISODE 7

EPISODE TITLE

House of Balloons: Chemistry's Innovative Forefront

PODCAST SUMMARY

Chemists never rest on their laurels. 159 years after the invention of the periodic table, they are still looking to find revolutionary ways to apply and organize elements. This episode of Western Science Speaks focuses on the dexterous ways in which Western chemists are manipulating the element Phosphorus, in order to create a brighter, greener future for our planet.

INTERVIEW

You're listening to the Western science speaks podcast. Presented by Henry Standage.

Henry Standage 0:14
Phosphorus is the chemical backbone to several processes integral to life on Earth, while also being crucial to the manufacturing of less essential operations, like fine china. Today on the podcast, we're going to explore the dexterity of phosphorus. To begin an interview with Professor Paul Ragogna from the Department of Chemistry at Western University. After we'll listen to a nationally presented Three Minute Thesis from student Vanessa Beland, who proposed the incorporation of phosphorus in order to repurpose old products. First Paul Ragogna.

Henry Standage 0:52
What makes phosphorus different than anything else on the periodic table?

Paul Ragogna 0:56
Phosphorus has a really unique property in the nucleus, which makes it pretty straightforward for chemists to make observations about what's going on in their chemistry using certain types of instrumentation. And this instrumentation is actually called nuclear magnetic resonance spectroscopy. It's kind of the chemist's version of an MRI and you know, we can observe the these nuclei, these elements in solution or we can observe them doing their chemistry almost in real time. You know, the technique coupled with the fact that phosphorus has such a diverse chemistry, it can be a medicine, it could be an insecticide, it can be an antimicrobial, it can be used in barrier coatings, and all this diversity plus our modern techniques allow us to really zero in on the chemistry of this element.

Henry Standage 1:57
When you're testing all this stuff what practical applications are you working towards?

Paul Ragogna 2:02
Because we got really good at plugging and playing different components around phosphorus, we can bias the properties of the resulting materials. And it's those resulting materials and properties that then we leverage for practical applications. Some of those practical applications, you know, are something we would broadly classify as barrier coding. So you could imagine, you know, you know, your dinner table or elevator buttons or light switches, they could have a coating on there that could be phosphorus based that is anti microbial, for example, but because chemists like myself and my students, undergraduate and graduate students and postdocs are playing with these elements and you know, really, you can think of my group kind of like a kid playing with Tinker toys, where, you know, you're plugging and playing different bonding arrangements, different atoms together and you're investigating what the outcome of that plugging and playing is, I would argue strongly that modern science conducted at universities and companies within you know, private sector companies with an intensive research

programme, it is all about creativity, it is all about trying to think outside the box and being imaginative about what you think could be possible and you know, sure those possibilities you're playing with in your mind, have to have some foundation and real science and you have to have some point where you can kind of plant your foot down and launch into that investigation. But it's really the world is your oyster, and how creative you are will really regulate how interesting your work is.

Henry Standage 3:53
Here's Paul's student, Vanessa Beland.

Vanessa Beland 3:58
Look at that red balloon, going up towards the atmosphere. Now our red balloon is garbage floating in the ocean just waiting for an unsuspecting sea turtle to eat it and clog up its digestive tract. That turtle is going to starve to death. How is it that a red balloon can wreck such havoc? You see, the balloon is composed of strong carbon bonds that cannot be broken down in the environment. On top of that, it's a plastic that cannot be recycled. And so, it gets discarded after one use. It turns out that on top of the 8 million tonnes of plastic that lands in the ocean every year, there are 100 million marine life casualties like the one that I just described. So, what are we going to do to reform this killer? I'm a chemist, and I say that we should repurpose used plastic so that it can be used in materials that help rather than hinder, we could take our balloon and change it from being rubbery to rigid and back again so that it can be used in a variety of different applications. To do so, consider the structure of plastic as being made of long pieces of string. In the same way that string can be knit into a more rigid structure. Plastic chains can be connected in a process called cross linking. For example, we could cross link our rubbery balloon to make it more rigid like the chairs that you're all sitting in. Now, cross linking is a well established technique. But the problem with the way that we do it industrially is that it is irreversible. Now that not only means more strong bonds that cannot be broken down in the environment, we also no longer have the option to make it rubbery again, which hinders our ability to repurpose. I've recently discovered a new way to crosslink plastic. It involves the incorporation of a phosphorus component into the material to make it more rigid. Now, the exciting thing about this phosphorus component is that it can be degraded. So, the idea is to make a plastic chair from a balloon. And then once we no longer require the chair, degrade it back into a balloon, which can now be used as a feedstock material to make all the different plastics that we use every day. Now, consider the implications. This science is an opportunity for us to mine plastic from the ocean to make safe habitats for sea turtles and other marine life. We'll also be making the water cleaner and safer for ourselves. And as a bonus, we'll be turning our garbage into guests. Thank you.

Henry Standage 6:48
Looking for new creative ways to utilise elements such as phosphorus has the potential to unlock something transcendent. Paul and his group take nothing for granted. They prod the periodic table that has been around for 150 years with a childlike play, as if it has just been invented. At Western, we're lucky to have a scientific community that seeks to find the extraordinary in the seemingly stringent. I'm Henry Standage, signing out. Thanks for listening.