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The Art and Science of Living in the Present (text and video)

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By: Rebecca Roesner

Thank you President Wilson. Good morning everybody. What, you might wonder, was swirling around in my mind when I decided that "Living in the Present" should be the message of today's talk? I suppose that I was thinking that today is a day of milestones in a season of milestones - one of many spring occasions where we pause to recognize extraordinary work, goals set and achieved, projects completed, grad school admissions, degrees conferred, jobs secured, and all of the adventures and opportunities that comes along with these events. While we certainly should pause to recognize and celebrate these achievements, there is also a risk in wagering too much of our happiness as we strive for the milestones. If we focus too much energy on life's itinerary and timetables, we're apt to miss much of its landscape, some fascinating fellow travelers, and a few serendipitous twists and turns. Our preoccupation with the milestones can tempt us to wish bits of our lives away. How many times have you thought I'll be happy or relaxed once I do this or that… once I finish the project… or take the test… or find the job… … … or give the big speech. I'm not suggesting that we compromise our goals, but rather that we allow ourselves to explore and enjoy and reflect along the way, and that we don't hold our happiness hostage to the milestones.

So, as the end of the semester tempts us to look backward and forward in a confusing swirl of satisfaction and anxiety, let's take a few moments to recount a few fascinating things that happened when people set aside their worries and distractions and took special notice of the present. My hope is that these successes will give us a little encouragement to focus on the journey rather the milestones and to prepare our minds for serendipitous moments.

Serendipity:

The word serendipity was coined by Horace Walpole (a British statesman), in a letter he wrote to Horace Mann (a Massachusetts statesman and educational reformer) in 1754. As an aside to the main business of his letter, Walpole was describing how the princes in a fairytale titled "The Three Princes or Serendip", what we now call Sri Lanka, were "always making discoveries, by accident and sagacity, of things they were not in quest of." This tale of three princes came to Europe through east/west trade and was first mentioned in the writings of Giovanni Sercambi (a

student of the 14th century Florentine writer Giovanni Boccaccio). The fairytale itself was published in Italian by Christoforo Armeno in 1557 and much later, in 1722, translated into English by way of a 17119 French version.

Serendipity, as we are going to use the term today, is therefore more than just luck - its accident and sagacity. Sagacity like, sagacious: Having or showing keen mental discernment and good judgment; shrewd. Or in the words of Louis Pasteur with respect to scientific endeavor:

"In the field of observation, chance favors only the prepared mind." Which by the way is a favorite quote of Professor Rettich's and I. Thank him for my knowledge of it.

This brings us to Luma Mufleh, the altruistic soccer coach featured in our summer reading selection, Outcasts United by Warren St. John. Luma had the well-prepared mind suggested by Pasteur - a degree from Smith,… the cross-cultural experience of growing up in Jordan and studying in the US,… and the mental toughness required to accept estrangement from her loving (but conservative and privileged Jordanian family) for the freedom to pursue unknown dreams in the US. It was with this prepared mind, but broken dreams from a failing cafe that Luma drove from her home in the Atlanta suburbs to Talars grocery store in the nearby town of Clarkston which was home to diverse refugee population.

But, as described by St. John, Luma "Distracted by her anxiety… inadvertently drove past the store, and had to make a U-turn in the parking lot of a dreary old apartment complex called the Lakes. While turning around, she came across a group of boys playing soccer on the asphalt. From behind her windshield she could see the boys playing the game with the sweet mixture of passion, joy, and camaraderie she recognized from the games played in the empty lot on the other side of the fence from her grandmother's house in Amman."

This chance encounter was the beginning of what has become Luma's passion and great success: the Fugees Family Academy and Soccer Programs.

While this sort of intellectually primed serendipity must happen in every field of endeavor, I'd like to share three fascinating stories from the history of science. And how they illustrate the good things that can happen in our life when we aren't looking, well looking but not planning.

Alexander Fleming, the year is 1928. He is a Bacteriologist at St. Mary's Hospital, London. And in addition to his dedication in his field of bacteriology, he also had what I sometimes call an odd hobby. And his odd hobby was microbe paintings. And so, he kept in his lab cultures of brightly colored bacteria and he would use his petri dishes as a canvas. And he would make these little things. And he belonged to the Chelsea Art Club in London and shared these things with them. And also shared water color paintings and things like this. And I think the fact that he would make paintings of out bacteria tells us that he was someone who loved his work. That's what I take out of this. So, more seriously though, I should mention... a bit earlier in his career in 1923, Fleming had discovered lysozyme, an enzyme found in tears, milk and other biological fluids, that damages bacterial cell walls. This Lysozyme could clear some varieties of bacteria from a culture dish. And that was all tucked away in his mind when, in 1928, after returning from a vacation, Fleming found a tuft of mold growing on a Petri dish of staphylococci that he had left in the lab during his vacation. And we'll recall now what he said about that event in retrospect:

> "But for the previous experience [with lysozyme], I would have thrown the plate away, as many bacteriologists must have done before…. It is also probable that some bacteriologists have noticed similar changes to those noticed [by me], … but in the absence of any interest in naturally occurring antibacterial substances, the cultures have simply been discarded…. Instead of casting out the contaminated culture with appropriate language, I made some investigations."

And as you can probably tell by now what Fleming had discovered, was penicillin. Although Fleming published his discovery of penicillin in 1929, he and his collaborators at St. Mary's hospital had only limited ability to produce, concentrate, and stabilize the active ingredient and ultimately they set that project aside. But, the development of sulfa drugs in the 1930s and then the threat of war produced renewed interest in antibacterial agents. And in 1938, Oxford's scientist, Howard Florey, and Ernst Chain resumed the work on penicillin. And they were able to generate significant quantities of the antibiotic and establish its clinical value.

This brings the story of penicillin to the USDA labs in Peoria, where Florey and Chain began collaborating with Andrew Moyer and his group. Moyer had a method of culturing fungus where he stirred it in big vats with something called corn steep water, which is a byproduct of wet

milling of corn that is done to make corn starch. And through this process, he was able to grow the mold and active ingredient in the mold, in amounts ten times what they had been able to do at Oxford. And simultaneously, the group in Peoria, started looking for the forms of penicillium mold that would produce the most active penicillin. And after searching and collecting samples of mold, the world over, it turns out that the winner was a Texas melon in a Peoria market. And so, there is this lovely sign here from a spoiled cantaloupe from Peoria, "the best of 1,000 strains of penicillium". So, a bit more serendipity in the whole story of penicillin.

So, Fleming, Florey, and Chain received the Nobel Prize in Medicine for their work in 1945. And, around that time, another colleague at Oxford, Dorothy Crowfoot Hodgkin, was working on the structure, the molecular structure, of penicillin. She used X-ray diffraction to determine that structure. And although today, this process is highly automated, and a trained scientist can determine a structure in a day and then spin beautiful 3D images of the molecules around on their computer screens; then it was mathematically intensive process that required great patience and discernment. And, the only way to visualize the organization of the atoms in the molecule was to build these 3-dimension models here with balls and sticks. And here the electron clouds of the atoms are actually mapped out stacked glass or Plexiglass plates. Dorthy also received the Nobel Prize; her's was in chemistry in 1964, "for her determinations by X-ray techniques of the structures of important biochemical substances". We now know that the active ingredient in penicillin is the molecule shown here, and that it key part of it is the part I highlighted in pink, - beta-lactam ring. And that we can vary the part of the molecule that is highlighted in blue. And the whole family of penicillin antibiotics bata-lactam antibiotics comes from synthesizing things like this or isolating them where there are different chemical groups in that place highlighted in blue.

And that brings us to the second story in scientific discovery, Roy Plunkett. Roy Plunkett was working at DuPont on the development of chlorofluorocarbon refrigerants. We may cringe a little now to hear this - knowing the damage these molecules have caused to the earth's protective ozone layer, but at the time those molecules were a tremendous improvement over the far more problematic ammonia and sulfur dioxide that were being used as refrigerants and sometimes poisoned people when the refrigerator failed. One of the reagents that Plunkett was using was gaseous tetrafluoroethylene and that was bought in these little compressed gas cylinders that are like the ones that patients use now if they need portable oxygen. And when he went to use it one

day, and he opened the cylinder up at the top, none of the gas came out. But he knows from weighing the cylinder that there should be gas in there. And so this was kind of disturbing. Where had it gone? What had happened?

Now a lot of people would have thrown the cylinder out or returned the cylinder to the manufacturer. But, he started poking in the opening with a wire trying to see if he could get it to come out. And he couldn't and he decided it wasn't blocked. And then in what would be a rather horrendous safety violation now, he decided to saw the thing open. And what he found inside was a white powder. The tetrafluoroethylene had reacted with itself and polymerized into a long-chain molecule that looked like that. And he investigated that powder and it has become what we now know as Teflon.

It had had some pretty amazing properties: it is chemically inert, high melting, and self-lubricating, and nothing would stick to it. So, we know some of the applications of Teflon, they started out doing bad things with atom bombs and things, but later they used it cookware and insulating electrical components and fabric treatments and all of that. And while I was reading on Google, I learned that it's so slippery that even geckos, those little guys that can crawl up a wall-- they try to crawl up and they just...fall right back down! But it was Google so, really, I had to do a more scientific search and it didn't take long. Google scholar, the Proceedings of the National Academy of Sciences, Alyssa Stark, a biologist at the University of Akron was studying Tokay geckos and she put little harnesses on them. And determined how many Newton's of force you need to apply to get a gecko to slip off a particular substance. But this is serious stuff, and right there PTFE, polytetraflouroethylene, you can see you only need about 2 Newton's of force, if the polytetrafouroethylene is dry, to get the gecko to slip. Which is far less than the 15 or more Newton's of force you would need for glass or poly methyl methacrylate, or treated glass. So, Teflon is slippery and another serendipitous moment in science.

And a final one, I'd like to share with you today is that of Lt. Gordon "Mouse" Cleaver. He was a Royal Air force Pilot in 1940. And he was flying in the Battle of Britain. He was flying one of these, a Hurricane Mark 1 plane and important for the rest of this story, it had windows made of the plastic, polymethylmethacrylate. Which we know is Plexiglass and which the Brits of that time knew as Perspex. Lt. Cleaver wasn't clever in one regard; he forgot to wear his flight goggles. And then he had another little problem, his plane got shot and-- this gets sad, but

something good came out of it. The Plexiglass shattered and the shards went in his eyes and he was blinded. But he was such a good pilot that he knew his controls well enough that he was able to roll the plane over, parachute out and he got rescued. And he came under the treatment of an ophthalmologist Harold Ridley. And as Harold Ridley performed many operations and was able to partially able to restore his sight and all of that. Harold made a really important observation. And that observation was that: the patient, Lt. Cleaver, wasn't having any rejection to the plastic in his eye. It was inert, it was there, and he recovered as much as he could. And it didn't cause any problems. And Harold Ridley's student, Steve Parry was making a comment while observing a cataract surgery that, "It's a pity you can't replace the cataract with a clear lens". And that comment in 1948, inspired Ridley to develop implantable lens to replace cataract coded lens. And they're now, you know, and for correcting other problems. And in fact, Ridley was scorned for this for a while because it was thought to be very dangerous to put foreign objects in people's eyes. He was rejected by the ophthalmologists, but this was eventually righted and he was knighted in the year 2000. And there's a stamp celebrating it. And the same set of stamps has a Fleming mold tuft on it too.

So, I'm over time, but I just wanted to share a bit of beauty from our own labs here at Illinois Wesleyan. These four students are in our chemistry 380 lab right now and they found some fascinating papers in the literature that they wanted to replicate. And they made this nice red powder of iron oxide, its fancy rust. When I say its fancy rust, if you look at it under the scanning electron microscope. Check this out, you've got all these structures, little leaves and flowers and these materials are being pursued because they might be able to absorb pollutants out of polluted waters. And they've got little poinsettia flowers and leaves and these little clusters. And so I just wanted to share a little bit of our own day to day beauty.

I also want to thank everybody here in the room and everybody here on campus for making this a really wonderful and fun place to work. I've experienced so much kindness in my 16 years here that it will take me, if I'm here another 32 years, I won't be able to repay it all. I also want to thank my husband Greg Pouch, for all of his love and support of my career and my preparation of this talk. And you owe him great thanks because he wisely talked me out of me telling you about the detailed history of dental implants.