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Serendipity and Leucippity

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We live among the many fruits of serendipity. Alphabetically, they include Aniline dyes, Blue leds, Corningware, Dark matter, Epoxy glue, Fullerenes and Graphene; Helicobacter pylori, Insulin, J/Psi particles, Kevlar, Lithium therapy, Magnetoresistance, Nuclear fission, Optical fibres, post-it notes, Quasars, Rayon, Scotchgard, Teflon, Uranic rays, Velcro, Warfarin, X-rays, Yinmin blue, and Zolpidem. But how did the word serendipity arise? It was taken from the title to an ancient Persian fairy tale, "The Three Princes of Serendip", wherein their highnesses traveled about, making unexpected discoveries by their keen perception, deductive skill, and good luck. Serendip may refer to Ceylon, now called Sri Lanka.

In 1748, the fairy tale was the inspiration for Voltaire's novelet Zadig, whose eponymous protagonist foretells, such famous fictional detectives as Poe's C. Auguste Dupin and Conan-Doyle's Sherlock Holmes. Six years later, the English man of letters Horace Walpole was so fascinated by the fairy tale that he coined the word serendipity to mean the discovery, through accidents and sagacity, of things one is not in quest for. The concept far precedes its coinage: think of Archimedes' eureka bathtub moment, or of a certain ninth century Chinese alchemist's explosive discovery of gunpowder, while seeking the elixir of eternal youth. More recent and much better documented was the 1669 isolation of phosphorus from his own urine by Hennig Brand, a similarly motivated alchemist. Ironically, his hometown Hamburg was incinerated in the massive Allied air raid of 1943 nicknamed Operation Gomorrah, and by means of the pyrophoric element Brand had inadvertently discovered.

In that same year, the Allied-occupied city of Bari was bombed by the Nazis in what became known as Little Pearl Harbor. About a thousand American and British troops were killed, as well as

many Italian citizens. Dozens of merchant ships sank, including one carrying thousands of American nitrogen-mustard bombs, to be used if and only if the Nazis resorted to poison gas as a weapon of war. The bombs exploded, releasing their lethal cargo over the port of Bari, injuring or killing many people. An American medical officer deployed to investigate the tragedy found the gas to have had the unexpected effect of suppressing white blood cell production. His classified report proposed that nitrogen mustard might be used 'off-label' to treat leukemia, thereby confirming the secret research then being carried out by two young doctors at Yale under federal supervision.

Soon after the war, the secrets were revealed and nitrogen mustard, under the trade name Mustine, became the first effective chemotherapy agent. Many serendipitous drug discoveries followed, such as Librium, LSD, and Viagra. It was reported a decade ago that the discoveries of 24.1% of all then currently marketed drugs can be traced directly to a serendipitous event, 35.2% for the case of anticancer drugs! Pharmacology has become a significantly serendipitous endeavor [1].

Oddly, the word serendipity was rarely used until rather recently. First mentioned in the New York Times in 1905, it had 12 citations therein by 1950, 1270 by 2000, and 3342 as I write.

The vital importance of serendipity in science was recognized in the 1950s by the renowned sociologist Robert K. Merton in the book he wrote with Elinor Barber: "The Travels and Adventures of Serendipity: A Study in The Sociology of Science." The book was completed in 1958, but first published in 2004.

Let me turn to leucippity, a word which I know you have never seen. Although I have used it in my talks and letters, this article is its

print debut. I intend leucippity to signify phenomena or hypotheses that are predicted long before being detected or confirmed. Leucippity is complementary to serendipity, in that an idea can be one, the other, or neither. My new word honors the elder of the two ancient Greek savants who proposed the existence of atoms, Democritus and Leucippus. It took over two millenia for their idea to become universally accepted.

Examples of leucippity abound in science: Einstein's gravitational waves were first detected in 2015, a century after they were predicted. Wegener's theory of continental drift waited half a century for confirmation, as did Peter Higgs's prediction of the eponymous bosons he and others had imagined in 1964. Their discovery was announced in Geneva on the 4th of July 2012. Wolfgang Pauli had to suffer a 25 year wait for his reluctantly predicted neutrinos to be seen, while Murray Gell-Mann waited a mere decade for his three quarks (and my charmed quark) to reach high-school physics textbooks.

I conclude with a rare example of a discovery involving both serendipity and leucippity. The American Vela satellites were

deployed during the 1960s to detect possible Soviet violations of the Limited Test Ban Treaty.

They searched in vain for upward directed gamma rays from banned nuclear explosions. Instead, the Vela satellites detected several unanticipated bursts of gamma rays coming downwards from the heavens. When secrecy was lifted in 1973, astronomers realized that something new and exciting had been discovered. Even today, these gamma-ray bursts continue to mystify astronomers.

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Conflict of Interest

No conflict of interest.

References

1. E Hargrave-Thomas, Bo Yu, J Reynisson (2012) Serendipity in anticancer drug delivery. *World J Oncol* 3(1): 1-6.