How "Bright" Is Your Curiosity?

~The Discovery of Glowing Protein from Jellyfish~

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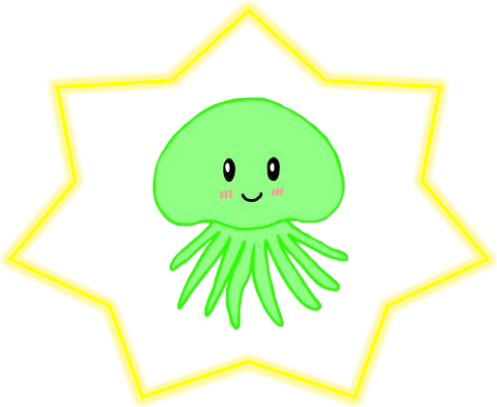

Here is a question for you. If someone asks, "Think of one naturally glowing organism," what organism would you think of? Fireflies, algae, jellyfish…there are many organisms in nature that glow in the dark, but have you ever wondered why they glow? Let me introduce the captivating story of Dr. Osamu Shimomura (1928-2018), a Japanese scientist who was intrigued by the mysterious glowing light emitted by jellyfish. His research career revolved around one simple question:

"why do some organisms glow?"

which left a significant impact on the world of science.

Born in Japan, Dr. Shimomura went through experiencing US atomic bomb in Nagasaki during his childhood. After graduating from the former Nagasaki Medical College (now Nagasaki University School of Pharmaceutical Sciences), he joined a research group at Princeton University in 1960. His research focused on studying bioluminescent jellyfish Aequorea Victoria to answer the question, "Why do jellyfish glow?" In 1961, he happened to discover a very small amount of glowing protein that he called "green protein" as a byproduct of calcium-sensitive protein aequorin. The "green protein" was later renamed to "Green Fluorescent Protein (GFP)" in 1971. [1]

In 1979, Dr. Shimomura finally identified the mechanism by which GFP emits light: the aequorin first reacts with calcium ions in the seawater and glows blue, which is then absorbed by the GFP protein to emit green fluorescence. After discovering the GFP, he continued his research to elucidate the mechanism of GFP glow to understand why the aequorin glows blue while the jellyfish glows green. However, since only a small amount of GFP could be extracted from one jellyfish, he and his family drove across the United States to Friday Harbor, Washington, known to have a substantial population of Aequorea Victoria

jellyfish. They caught over 850,000 jellyfish to extract enough GFP to investigate the question of "why the jellyfish glow green?" [2]

Here is the intriguing part, though. After 1979, Dr. Shimomura terminated his research regarding GFP to focus on studying different bioluminescence species driven by his deep curiosity of "why some organisms glow?" He never envisioned the potential application of GFP. In fact, the beautiful green glowing protein, GFP, actually remained useless for over 30 years after its discovery. However, in the 1990s, with the rise of genetic engineering, the ability of GFP to generate green fluorescence by itself under blue light has come into the limelight. Dr. Shimomura's discovery led to the identification of the GFP gene, and subsequently, genetic recombination technology made it possible to "mark" GFP on other proteins we want to examine. In 1994, a biologist Dr. Martin Chalfie, who was researching ringworm C. elegans, succeeded in inserting the GFP gene into an organism other than jellyfish as a marker, allowing the movement of the protein to be tracked. Dr. Martin Chalfie's research sparked the widespread use of GFP as a marker not only in C. elegans but also in other organisms. [3] Then, a biochemist, Dr. Roger Tsien, modified GFP proteins and created a colorful rainbow palette of fluorescent proteins, including red, blue, and yellow, making it possible to observe multiple proteins and cells simultaneously using different colors. Fun fact, some of these colorful fluorescent proteins have fruity names such as mCherry for red, mBanana for yellow, and mOrange for orange. [4]

Fast forward to the modern days, GFP and its analogs are used in various scientific research, and it is especially indispensable in biomedical research. It allows us to observe the growth of cancer cells or even track the death of nerve cells in Alzheimer's disease. It is also expected to be effective for treatment, selectively labeling cancer cells so that they will glow to enhance the distinction between cancer cells and healthy cells. We could even track plant diseases. [5]

When Dr. Shimomura discovered GFP from the glowing jellyfish, little did he know that his genuine curiosity would lay the foundation for a scientific revolution. In fact, after the termination of the research on jellyfish, the jellyfish population in the Friday Harbor suddenly declined after the 1990s due to some natural cause or pollution from the oil spill [1]. This means that if he hadn't started exploring his curiosity about jellyfish, trying to answer the question of "why jellyfish glow" in the 1960s, he probably would have never discovered the glowing green protein, and none of the current scientific research advancements would not have been possible.

In 2008, Dr. Shimomura, Dr. Martin Chalfie, and Dr. Roger Tsien received the Nobel Prize in Chemistry "for the discovery and development of the green fluorescent protein, GFP." Although Dr. Shimomura never anticipated the application of GFP in other research and said in the interview,

"*I don't do my research for application or any benefit. I just do my research to understand why jellyfish luminesce,*"

he unknowingly planted a seed in the field of science, which took over 40 years to flourish with contributions from many scientists, including Dr. Martin Chalfie and Dr. Roger Tsien. [2] Even today, many scientists build upon this knowledge and continue to expand their research, unveiling new findings in the world of science. But remember, the groundbreaking advancement in science started from one simple question,

"why jellyfish glow?"

so embrace your curiosity. Why? Because you could be the next scientist to plant a new seed into the world of science that has the potential to flourish in the future. This is the joy of being a scientist—you never know how your findings might shape the future of science. So let me ask, how bright is your curiosity?

References

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Methods and Acknowledgement

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