

Light the Light of Life

点亮生命之光

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Introduction

Most important biological techniques are the modification and usage of fluorescence protein and light sensitive protein. Fluorescence protein just like a window of life, space and time, precisely shows the information of biological structure and dynamics. Light sensitive protein, is a flexible and potential switch to control the behavior of life. Here I will show the brief history and theory of them. Then I will show the unique role in the past 10 years, and imagine how they deepen the understanding of life in the next 10 years.

Fluorescence Protein

Fluorescence protein makes a difference for **live cell image**, which unlocks the observation in dynamics and in vivo.

For me, the most amazing and impressive story is tracking the development of *Drosophila* embryo labeled by multiple fluorescent protein. When we are children, we are curious how the tadpole changes to a frog and how the worm grows to a beautiful fly. So we collect the tadpole, and observe the change of its body by naked eye. It is so natural to feel curiosity for development. Not only curiosity, but also a mission to care the question of development. Our predecessors have almost observed the macrophology during development in detail. With the development of cell biology and molecular biology, we can deepen into the more fundamental level and focus on the differentiation during development (track the fate of cells from embryo). In 1905, Edwin Conklin published a remarkable fate map of ascidian embryo, after hard work under light microscopy. Also, in 1985, John Sulston used light microscopy (DIC) to determine the fate of every single cell in the *C. elegans* embryo. With the light-sheet microscope, Fernando Amat produced a clear and complete track on *Drosophila* embryo. Light sheet contributed a lot to this work, but fluorescence protein plays a unique role compared to dyes and others. If we use chemistry dyes, we will be lost due to cell differentiation and proliferation.

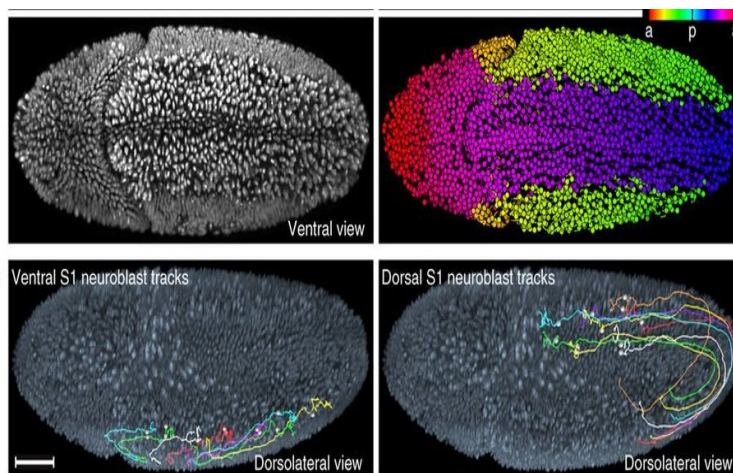


Figure 1. Automated cell lineaging in *Drosophila* embryo

In fact, fluorescence protein have been found before many years ago. During many scientists' hard to evolve better fluorescence protein. In general, fluorescen protein produce the observation in vivo, in dynamics, in functional specify, time and space locally, heritable. Fluorescen also can be a sensor in vivo, such as pH or other factors.

No only above, fluorescen protein also enhance or lead to following tech: Flow cytometer, Photobleaching, FRAP, Photo-Activated Localization Microscopy(PALM), Stochastic Optical Reconstruction Microscopy (STORM).

Light Sense Protein

Light sense protein can be a flexiable and specify expressed switch in vivo, under the light control in spatial and temporal.

1. Optogenesis: Powerful "hand" for neuoscists to understandin how neuro be a brain and cure the diease.
2. This unique tool can lead to some intersting problem.

Summary

They answer some important question, and also help the develop of other tech and work in next 10 year.

Reference

- i. <https://www.quantamagazine.org/light-triggered-genes-reveal-the-hidden-workings-of-memory-20171214/>
- ii. The lecture slides of Biotech courses