How does the mystery of the **Chinese cat** eyes relate to the **evolution** of **vision** in **mammals** ?

Julián Monge-Nájera

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The domestic cat, *Felis catus*, originated in the **African wildcat** species complex, a group that inhabits tropical and subtropical areas, reaches the warmer parts of Western Asia.

Early in mammals' history, adaptation to nocturnal life favored higher light sensitivity over color perception

The eyes of domestic cats are so similar to ours that human eye cells injected in cat eyes develop perfectly[1]. There are also differences, the phrase "*all cats are grey in the dark*" reflects a physiological reality: at low light levels, human eyes only use cells called ***rods***; and rods cannot perceive colors. But cats see well and in color even in low light, thanks to a combination of rods and color sensitive cells called *cones*[2].To understand why, we must go to the past.

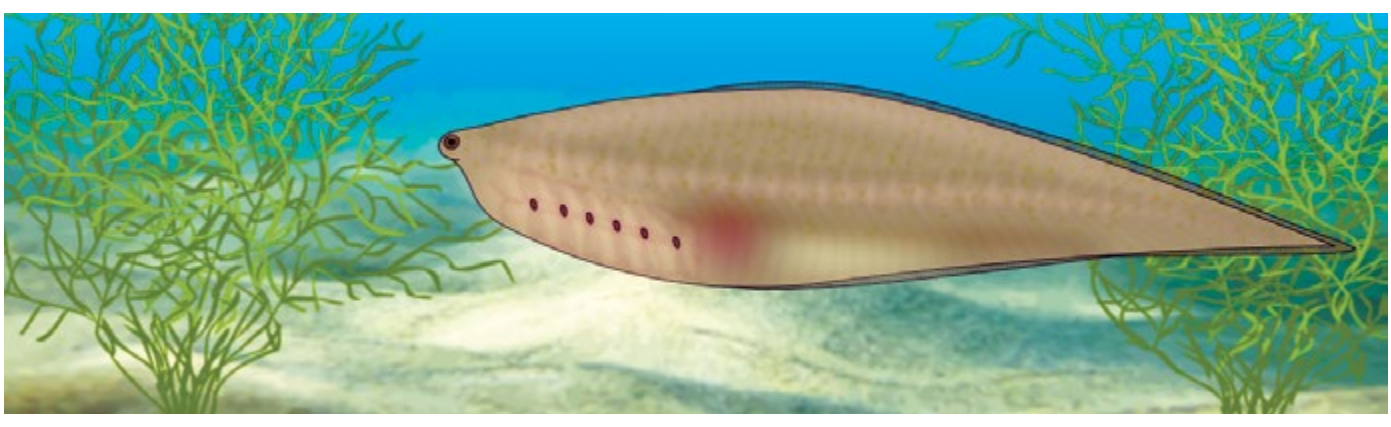
Over 500 million years ago, fish without jaws evolved the first rods, thanks to a mutation that modified some cones, making them more sensitive to light, at the expense of color[3]. When their descendants, the reptiles, colonized the land, they had good color vision in strong and weak light. Why do most extant mammals have a less impressive vision?

The night bottleneck hypothesis states that, early in mammal's history, adaptation to nocturnal life favored higher light sensitivity over color perception. Recent work based on DNA is consistent with this hypothesis and adds that early mammals were also able to see **ultraviolet** light[4], a very advantageous trait shared, among others, with moths and nocturnal lizards[5]. At night, the combination of other light frequencies with the ultraviolet, allowed them to easily distinguish seeds, fruits and insects from their surroundings; a trait that most mammals lost during this early adaptation to night life.

But many nocturnal mammals today have recovered good low light vision thanks to a new mechanism, a reflector, called the ***tapetum lucidum***, which increases the light reaching the sensors and allows the use of both rods and cones at night. But this comes at a cost: the reflector is always there, sending too much light during the day. They need a very good pupil system to protect the eyes in changing light, and this brings us to the story of the Chinese cat*:

> *An imperial agent is sent to investigate the disappearance of nuns and the death of a monk in a Chinese monastery. The abbot tells him that at noon the monk sketched a cat, and shortly after behaved strangely, described religious visions that he was having, and died. A theologian was called in to explain the obscure meaning of these visions.*
> *Later on, while the abbot eats meatball soup, the investigator tells him:*
> *—I know that you lied to me.*
> *The abbot confesses: he killed the nuns and poisoned the monk. But he is not afraid of the emperor's justice, he will die soon: folded inside the meatballs are sharp bamboo blades that will expand when the tendons that hold them in place are digested.*

How did the investigator know that the abbot had lied? He saw the sketch and it could not have been painted at noon: the pupils of the cat were too open; cat pupils close as the day becomes brighter —a form of protection they evolved for the delicate sensors needed to hunt by night—.



There is ethnological support for the story: Father **Évariste** Régis Huc, who traveled through the Chinese empire in the early 19th century, wrote that, when the sun was not visible, the ancient Chinese guessed the time based on how much their cats' pupils contracted[6]. This is a beautiful meeting between cat physiology and human culture, and particularly interesting now that we live in a world of artificial light from lamps and telephone screens. What are the implications for our own visual evolution?

**Note:* I watched the Chinese cat story on television when I was young, but I could never find the show's name.

Julián Monge-Nájera
Laboratorio de Ecología Urbana, Universidad Estatal a Distancia
San José, Costa Rica

Images

Cat eye close up. Source: **Felinest** (**CC BY 2.0**)
Cat painting. Source: **Ren Bonian** (Dominio público)
An artist's concept of *Metaspriggina*; vision in low light conditions was first developed, among vertebrates, by Cambrian fishes. Their descendants, early mammals, had color vision day and night, but lost most color vision when they adapted to nocturnal life. Source: **Giant Blue Anteater** (**CC BY 3.0**)

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