

A FASCINATING  
JOURNEY ALONG  
THE EYES OF ANIMALS

**FRANK JOSEPH GOES**

STERCK & DE VREESE



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# FOREWORD

I had the pleasure of making the acquaintance with a Flemish pop band I did not know, Mooneye. She turned out to be named after a North American freshwater fish in need of clean water and who, as a result, has become rare.

It must be about the dullest fish I have ever been immersed in, because there was really nothing exciting to be detected. Except for the big beautiful silvery-white eyes that the species have given her name. The kind of eyes that you spontaneously fall for. Did the band know the fish? She did not, by the way. She just chose the name because he sounded so good and was so romantic, and she had just discovered afterwards that it was also the name of a fish. The scientific name is *Hiodon tergisus*.

Eyes can charm, even fisheyes. Why do we think the giant panda is such an attractive animal? Because its small eyes are greatly magnified by black spots and he has a babyish character, although they are grumpy animals with an unappealing lifestyle of eating a lot of bamboo and who produce a lot of greenish droppings.

Why are young dogs so cute? Because they have a so sheepishly endearing look with their big eyes. The person who exposes the genetics behind neoteny – lifelong preservation of childlike features – will be rich very soon. Preservation of large children's eyes would be a classic in a story like that.

Eyes have arisen in many places in the animal kingdom. They are a textbook example of what scientists call convergent evolution: properties that, in various places in the animal kingdom independent of each other, have arisen because, being able to see, has a high survival value. Although, that 'independent' is an elastic understanding, according to scientific experiments.

What did the experiments, from under more Belgian scientists, prove? That one can perfectly turn on the gene at the basis of eye formation in fruit flies in mice, where it will form a mouse eye. Conversely, the gene which is at the base of a mouse's eye may form fly eyes in a fly. This is because the gene (called Pax-6) is in both cases the same.

That is bizarre, because the eyes of mice and flies are completely different: flies have facet(compound) eyes, mice have retina-eyes, just like us, which implies that the flies could also initiate our eye formation. There is of course much more involved in making an eye than just that one gene, but the interchangeability illustrates that being able to look very early in the evolution of life must have been discovered and cultivated as a solution to do better than the predecessors.

Eyes also have the discoverer of the mechanisms for the evolution of life, the British Charles Darwin, kept very busy. Critics of his theory of natural selection – life evolves through small changes and the useful are selected and stored – used the eye as an example for their thesis that natural selection was nonsense, because in their vision it was impossible to half see. So, an eye had to be created in its integrality by a brilliant Creator-by God.

But Darwin countered that argument with the reply that you can, indeed, half see. When you are in complete darkness and you get some light-sensitive cells, as an animal, you can get a (small) advantage out of that. So, you can have an evolution of always seeing a little bit better until you eventually get eyes, like our retinas or the facet eyes of invertebrates.

Scientists have calculated that you do not even need that much time for that: two thousand generations, if everything goes smoothly, would suffice. By evolutionary standards, that's peanuts.

It is merit of ophthalmologist Frank J Goes that he has summed up the versatility of eyes and has looked it up into the animal kingdom in a widely illustrated book – he already has a tradition in publishing such books. The book ploughs through the animal kingdom in search of ordinary and special cases, giving it insight into how life has invested more and more in the ability to see, and how the adaptations to the various eye types happened. The versatility of life, which possibly is made by that highly flexible mechanism which is natural selection, splashes off the many pages of this book.

It also pays attention to practical questions, such as the issues of how your dog or cat sees in your living environment and how eye diseases that affect domestic and farm animals can be fought.

The book is not going to be the real ‘special cases’ out of the way, like the ‘Sky viewer’ and the ‘Stargazer’: two ugly fish species with a beautiful name and with upward-facing eyes (in fact three, because there’s a cultivated variety of the goldfish which has upward-facing telescopic eyes, with which he can see so badly that in nature he wouldn’t survive long).

The book also focuses here and there on the way back and discusses that nature has been invaded by the evolution of blindness in animals that could see at first, but, because of their living in the darkness of caves or the deep sea’s, do not need eyes anymore.

Nature does not invest in something that is not useful – that is a waste of energy.

But you can be assured: this is a useful book where a lot of time and energy has been spent on it. Congratulations to the author!

Dirk Draulans, evolutionary biologist



*Stargazer or  
perciform fish*

ON  
THE ORIGIN OF SPECIES

BY MEANS OF NATURAL SELECTION,

OR THE

PRESERVATION OF FAVOURED RACES IN THE STRUGGLE  
FOR LIFE.

By CHARLES DARWIN, M.A.,

FELLOW OF THE ROYAL, GEOLOGICAL, LINNÆAN, ETC., SOCIETIES;  
AUTHOR OF 'JOURNAL OF RESEARCHES DURING H. M. S. BEAGLE'S VOYAGE  
ROUND THE WORLD.'

LONDON:

JOHN MURRAY, ALBEMARLE STREET.

1859.

*The right of Translation is reserved.*

**FIGURE 1**

*The title page of  
world-famous  
On the Origin of  
Species by Means  
of Natural Selection,  
or the Preservation  
of Favoured Races in  
the Struggle for Life*

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# INTRODUCTION

Compared to the animal kingdom, Man is almost *the* expert at the sensory level: only birds surpass us as far as eyesight is concerned, and some animals, such as the dog, have a sense of smell and hearing that is better than ourselves.

Three quarters of information comes to us through our eyes. Light, colour and vision dominate the world and most living creatures have eyes that process images. Over a period of millions of years their eyes developed along different paths, evolving from simple pigment stains to extremely complicated registration systems. These alone demand admiration of the complexity of all living creatures.

Many readers know that insects have different eyes than us, but few will have an answer to the following questions: Does an insect see one image or many different images? What colours can my dog see? Why do fish have different eye lenses than we do? There are about ten different ways in which an eye can form an image: mirrors, telescopic systems, pinhole systems and groups of lenses are just a few of them.

Imagine that an eye, in all its astonishing complexity, allows a quantity of light to pass into the eye and see during both day and night; to correct spherical and chromatic aberration; to accommodate and distinguish colours, would have come about through natural selection. It seems absurd, and yet it is a fact! Even Darwin was astonished when he described in 1859, the logic of 'living on earth'.

A pair of eyes at the front of the head is a familiar and an efficient solution to see, but absolutely not the only one: cockles and mussels have eyes on the mantle, beetles and snails have eyes all over their backs, starfish have eyes on the ends of their arms, some of the jellyfish have no brains but complex eyes, many spiders have four pairs of eyes, etc. & etc.

Hunters, like the felines including lion, tiger, and the cat, have their eyes placed on the front of their head that helps them detect their prey and to judge the right distance for a successful attack. On the other hand, the hunted, (rabbits, and farriers) have eyes that are implanted on the sides of their head and that is useful to prevent danger from predators who can approach from all directions. Sedentary shellfish live in, yet another world compared to a flying insect, and thus require a different optical method in order to spot danger and close its shell, or open to receive floating food.

Which eyes came to which animals and when did they arise? We have tried to classify and describe the order and the logic of it.

An introduction along Earth's geological time scale indicating when certain animals appeared, a detailed description of function and anatomy of the eye, and a reflection around consciousness in animals should not be missed, and therefore I included it.

At the end of the book, I have described the eyes, and also some other functions, of animals that we know well and sometimes we fear.

Frank Joseph Goes, Eye M.D.