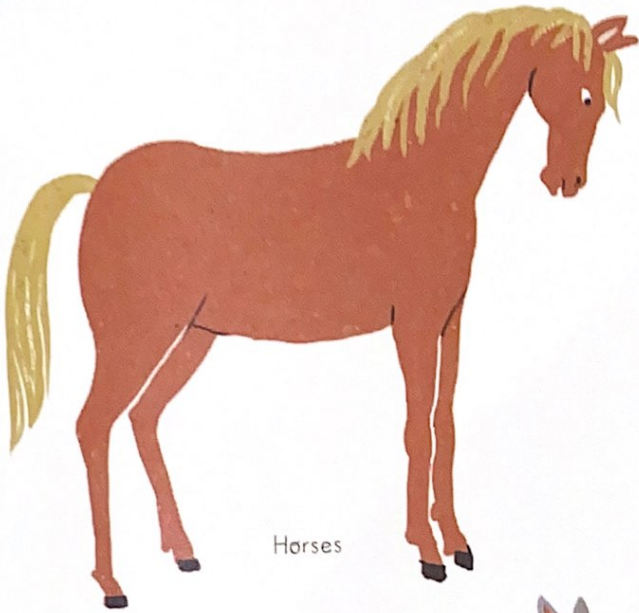


Over a really long time, these little differences can add up and a species can change so much that they become a whole new species. Darwin suggested that this is a really slow process, taking tens of thousands of years. That's why it's hard to see evolution happening with our own eyes!

Of course just as new species form, others die out or become extinct.

* See Appendix IV and V

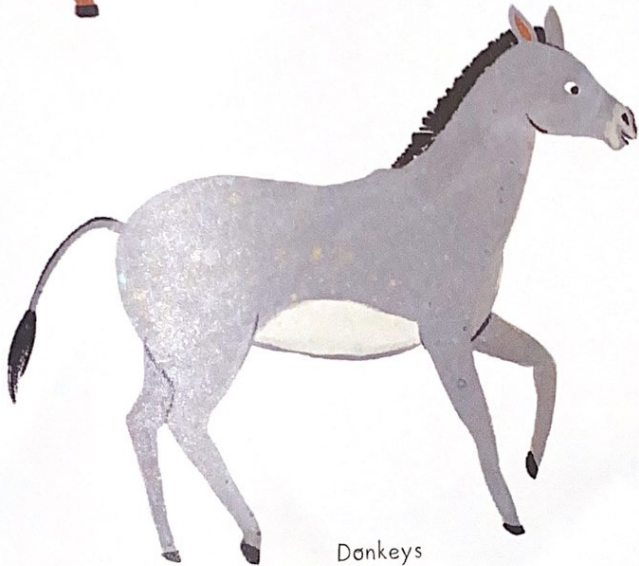
GENUS EQUUS



Horses



Zebras

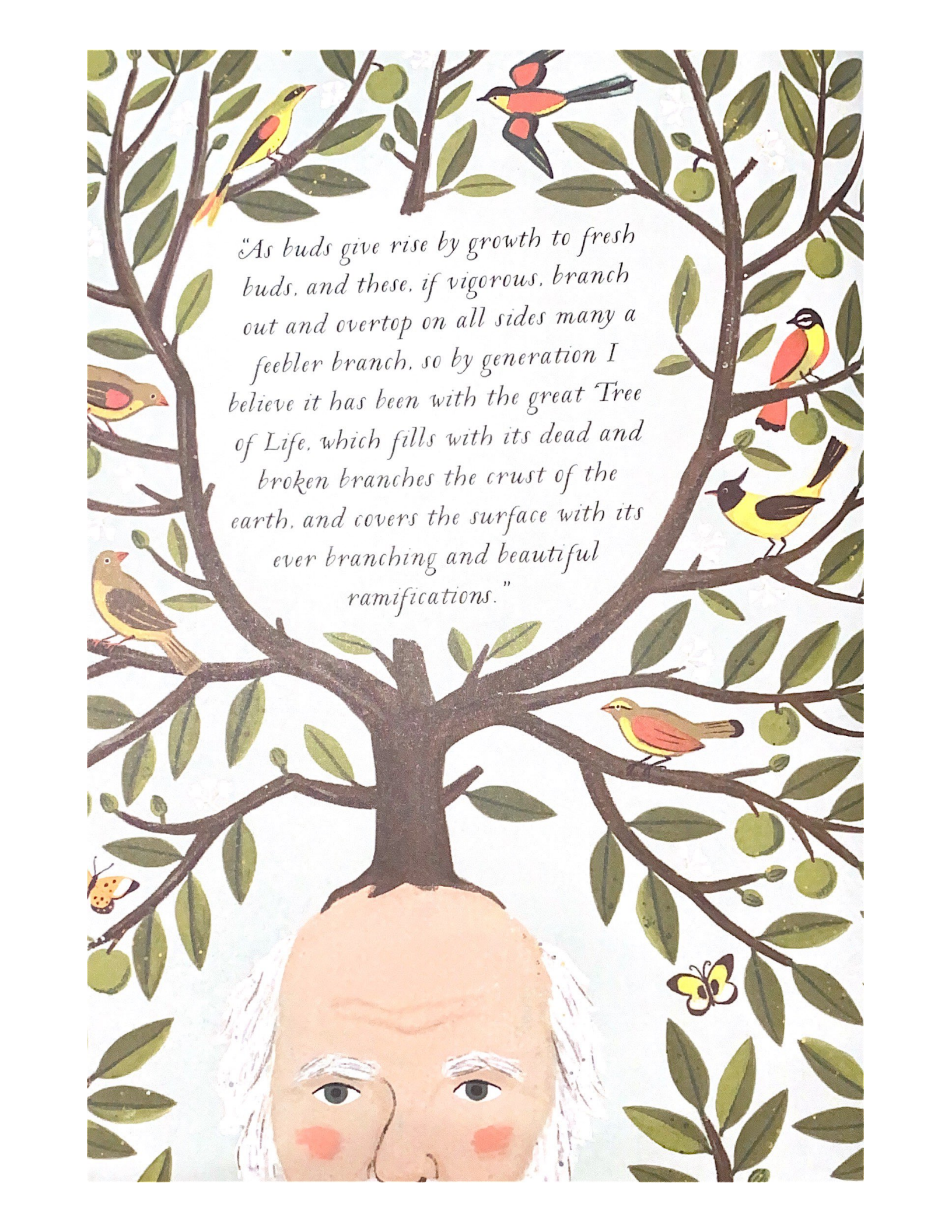


Donkeys

Closely related plants and animals
all come from one original species.
The wider group of relatives
is called a genus.

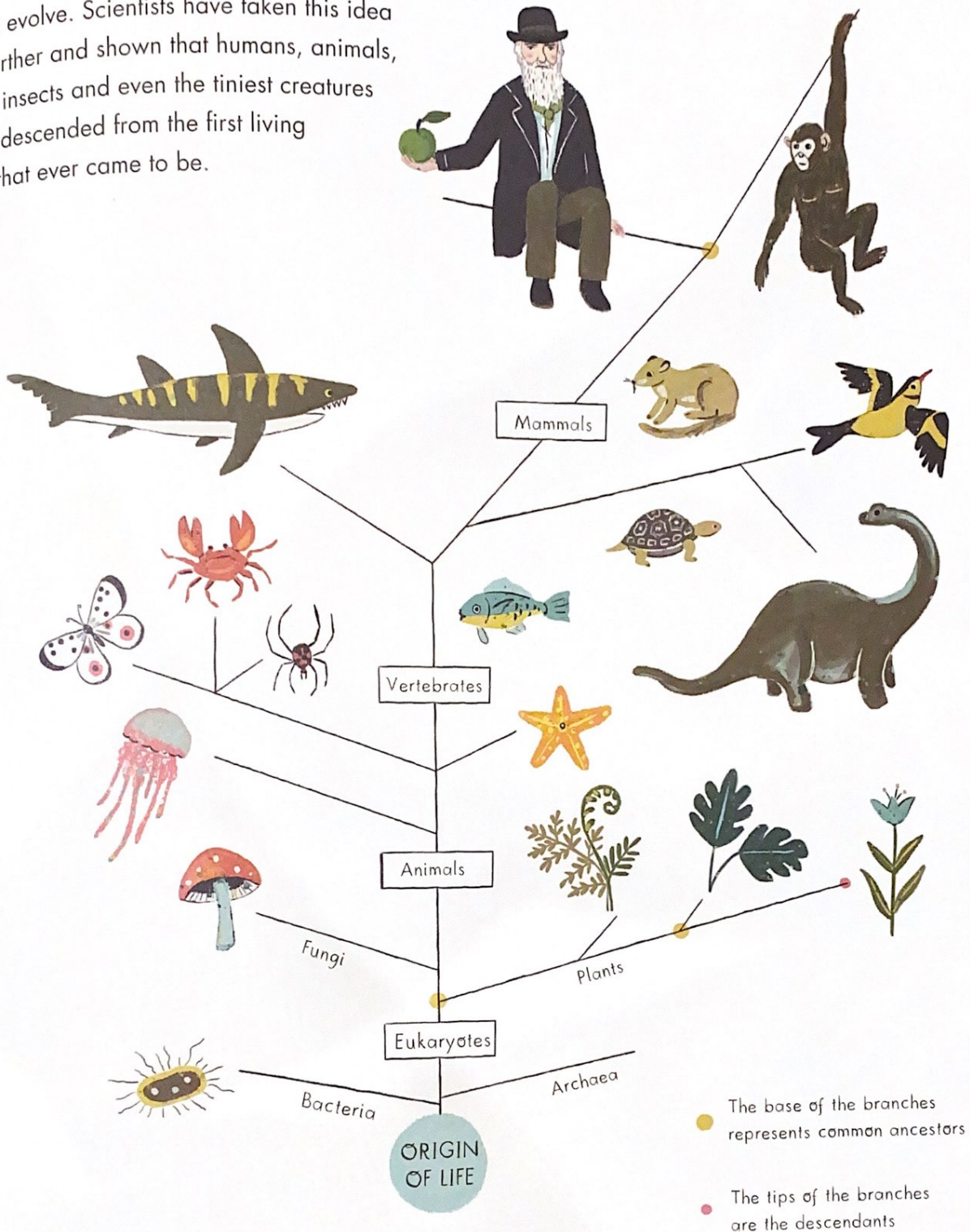
Sometimes features that seem to have
vanished forever can suddenly reappear.
For example, some Devonshire ponies
are born with stripes just like zebras,
which suggests they may share
a stripy common ancestor!






"As buds give rise by growth to fresh buds, and these, if vigorous, branch out and overtop on all sides many a feebler branch, so by generation I believe it has been with the great Tree of Life, which fills with its dead and broken branches the crust of the earth, and covers the surface with its ever branching and beautiful ramifications."

Darwin drew a picture of a tree to show how species evolve. Scientists have taken this idea even further and shown that humans, animals, plants, insects and even the tiniest creatures are all descended from the first living things that ever came to be.



So how did life begin? Where did it first come from? Darwin wasn't sure, but his theory explains how it evolved into the many living things we see on planet Earth today.



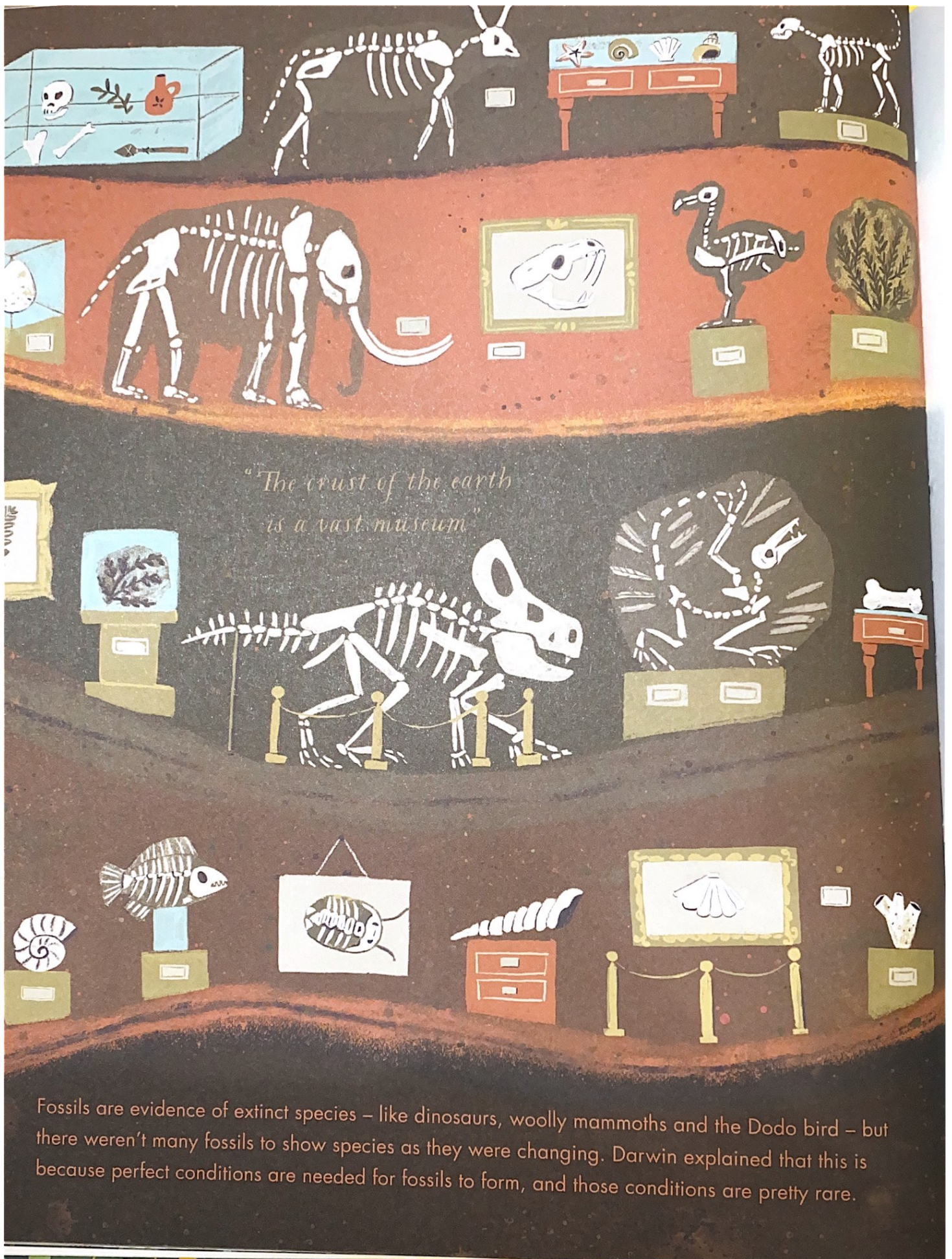
"Why, if species have descended from other species by insensibly fine gradations, do we not everywhere see innumerable transitional forms? Why is not all nature in confusion, instead of the species being, as we see them, well defined?"

Difficulties on Theory

Darwin knew that his theory was difficult to prove, and that people would ask questions about it. His book is filled with answers to those questions – for example: if species gradually change over time, why do we not see many in-between forms, in the middle of all these changes?



Darwin explained that Natural Selection makes living things better adapted to where they live. Once animals with more useful traits appear, they will compete and replace those that are less adapted.



*"The crust of the earth
is a vast museum"*

Fossils are evidence of extinct species – like dinosaurs, woolly mammoths and the Dodo bird – but there weren't many fossils to show species as they were changing. Darwin explained that this is because perfect conditions are needed for fossils to form, and those conditions are pretty rare.

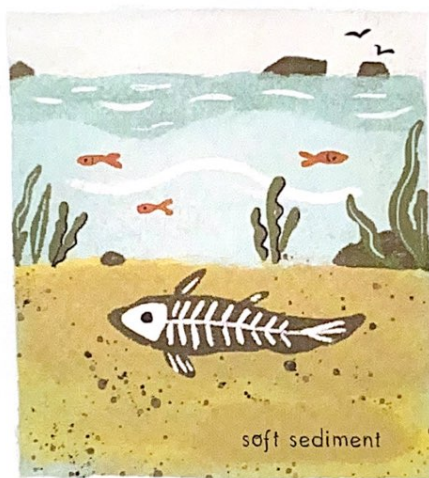
Imperfections of the Geological Record



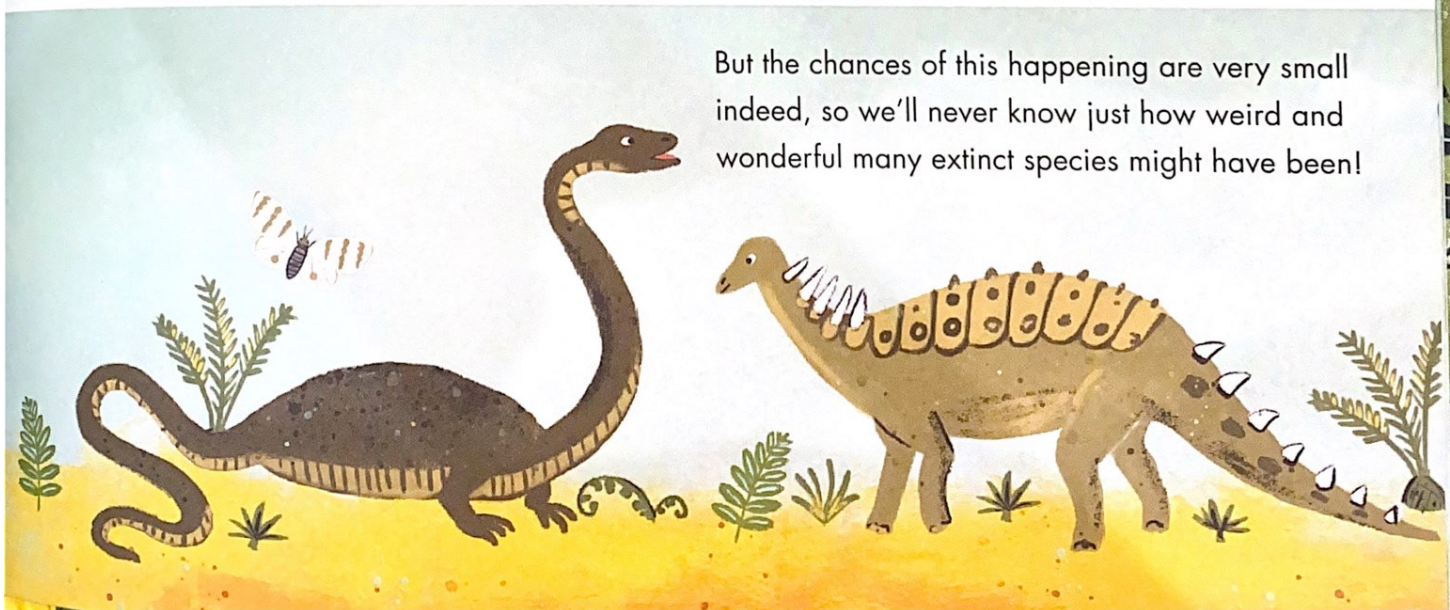
As rocks get bashed by the wind and sea, they break down into pieces called sediment.

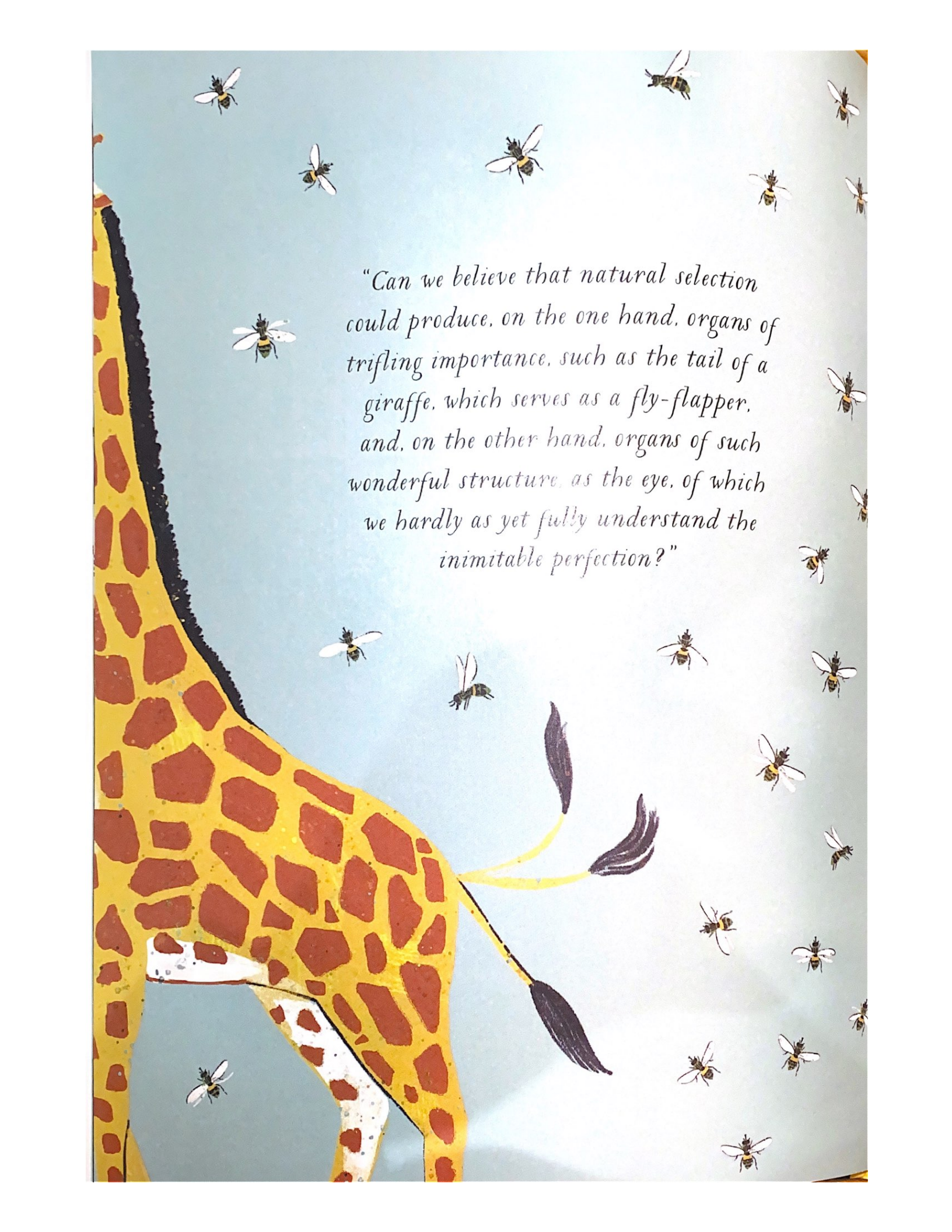


When animals die and get covered in layers of sediment, like a blanket, they can be preserved in sedimentary rocks.



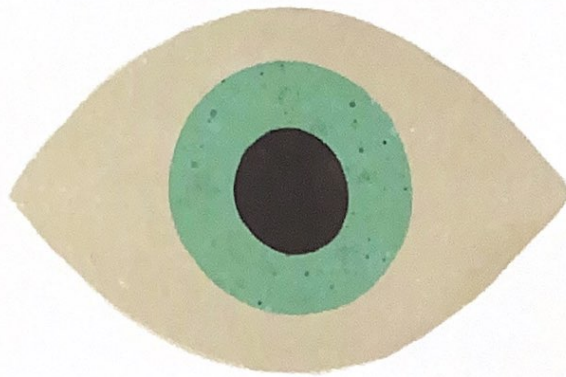
But the chances of this happening are very small indeed, so we'll never know just how weird and wonderful many extinct species might have been!



An illustration of a giraffe's neck and tail against a light blue background. The giraffe's neck is yellow with large, irregular brown spots and a black mane. Its tail is yellow with a black tip and a tuft of dark purple hair. Numerous bees are flying around the giraffe. In the center, there is a quote in a cursive font.

"Can we believe that natural selection could produce, on the one hand, organs of trifling importance, such as the tail of a giraffe, which serves as a fly-flapper, and, on the other hand, organs of such wonderful structure, as the eye, of which we hardly as yet fully understand the inimitable perfection?"

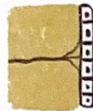
Organs of Extreme Perfection



EVOLUTION OF THE EYE



light-sensing
spot



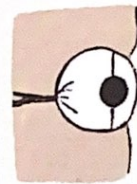
photosensitive
patch of cells



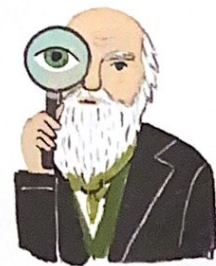
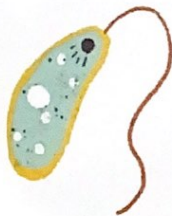
eye cup



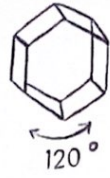
pinhole eye



camera eye



According to Darwin, animals become more complicated as they evolve and new body bits are made from the old designs, rather than being started from scratch. Very complex organs like eyes evolved from what were simple designs to begin with. The eye was formed by tiny changes and upgrades over millions of years.



“What shall we say to so marvelous an instinct as that which leads the bee to make cells, which have practically anticipated the discoveries of profound mathematicians?”





Instinct

Natural Selection doesn't just focus on how creatures look, but also on how they behave. Instinct is the seemingly magical way an animal is born knowing how to work with its environment. For example, many birds somehow know they must travel to warmer places during winter; and honey bees create perfect hexagon shapes in which to store their honey, without ever being taught. These are examples of instincts and, if an instinct helps an animal to survive better, it can be kept and passed on to future generations.



Mountains, rivers and seas create natural barriers to migration, and many animals have difficulty crossing oceans.

Plant seeds can be carried or eaten by birds and 'deposited' later, allowing them to spread more easily. This is why plants around the world often seem similar, but animals in different places are more different!

Darwin explained how species spread around the world by something called migration. New species that start in one place will sometimes move to other places. In their new environment, the species will often change even more.

Migration

Because they are surrounded by water and cut off from the mainland, islands have become home to some of the most unusual animals on the planet. One BIG example of these unusual animals, spotted by Darwin, was a giant tortoise in the Galapagos Islands.



Pinta



Isabela

Florena

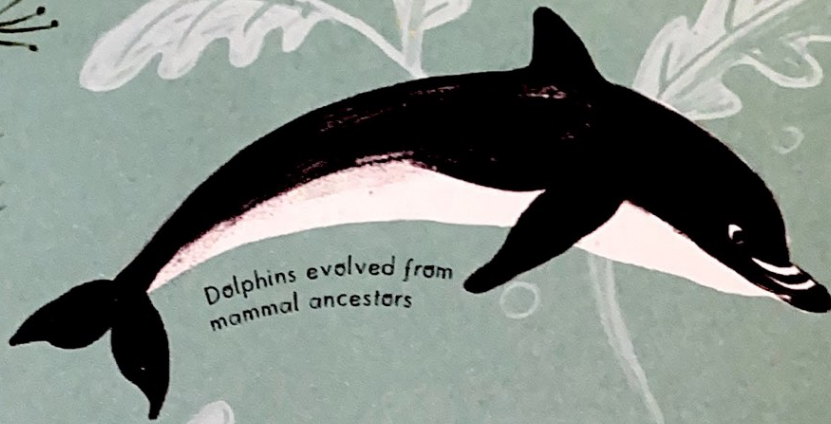
GALAPAGOS ISLANDS

Hood



250kg (550 pounds)

It is thought that an ancestor of that tortoise floated to the island. With no predators or other large plant-eaters to compete with for food, the tortoise did very well for herself, as did her descendants. So far, evolution has caused the giant tortoise to get bigger and bigger over time, and it now weighs in at over 250kg.



Dolphins evolved from mammal ancestors



Sharks evolved from fish ancestors



Ichthyosaurs had reptile ancestors

Interestingly, some animals have developed similar body parts without being closely related, just by living in the same environment.

Mutual Affinities of Organic Beings

whale fin

bat wing

*"From the first dawn of life,
all organic beings are found to
resemble each other in descending
degrees, so that they can be classed
in groups under groups."*

dog paw

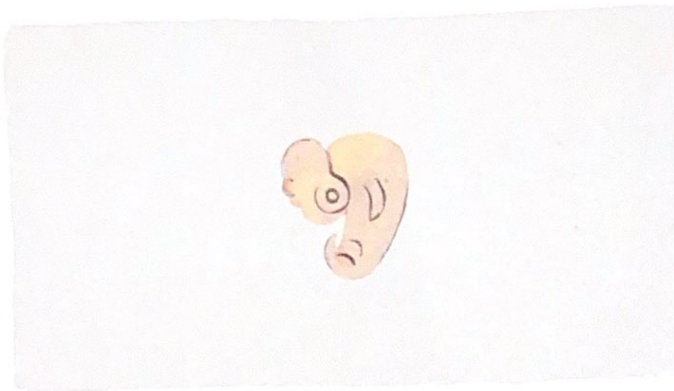
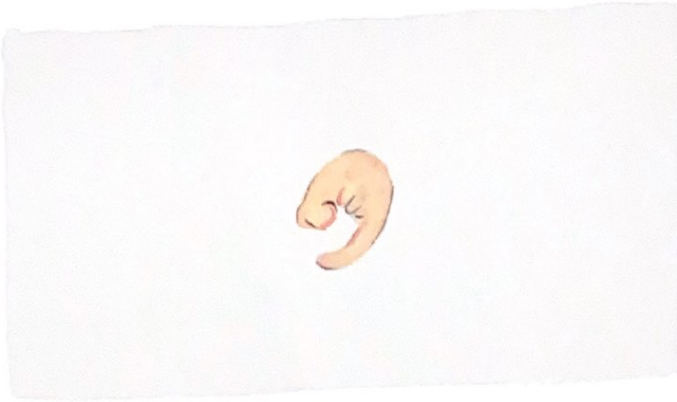
frog leg

human hand

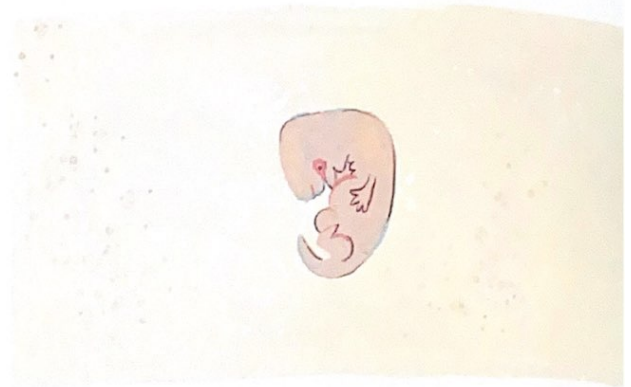
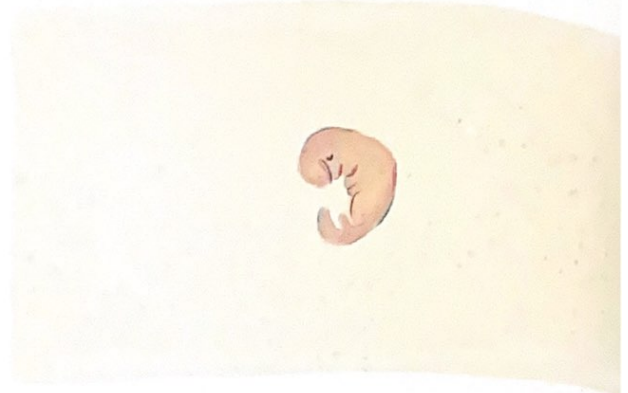
lemur leg

Naturalists usually rely on the insides and bones to find out if species are really related. For example, many species share the same five-fingered bone structure in their hands, paws or flippers. This points to a shared branch in the tree of evolution.

CHICKEN EMBRYO



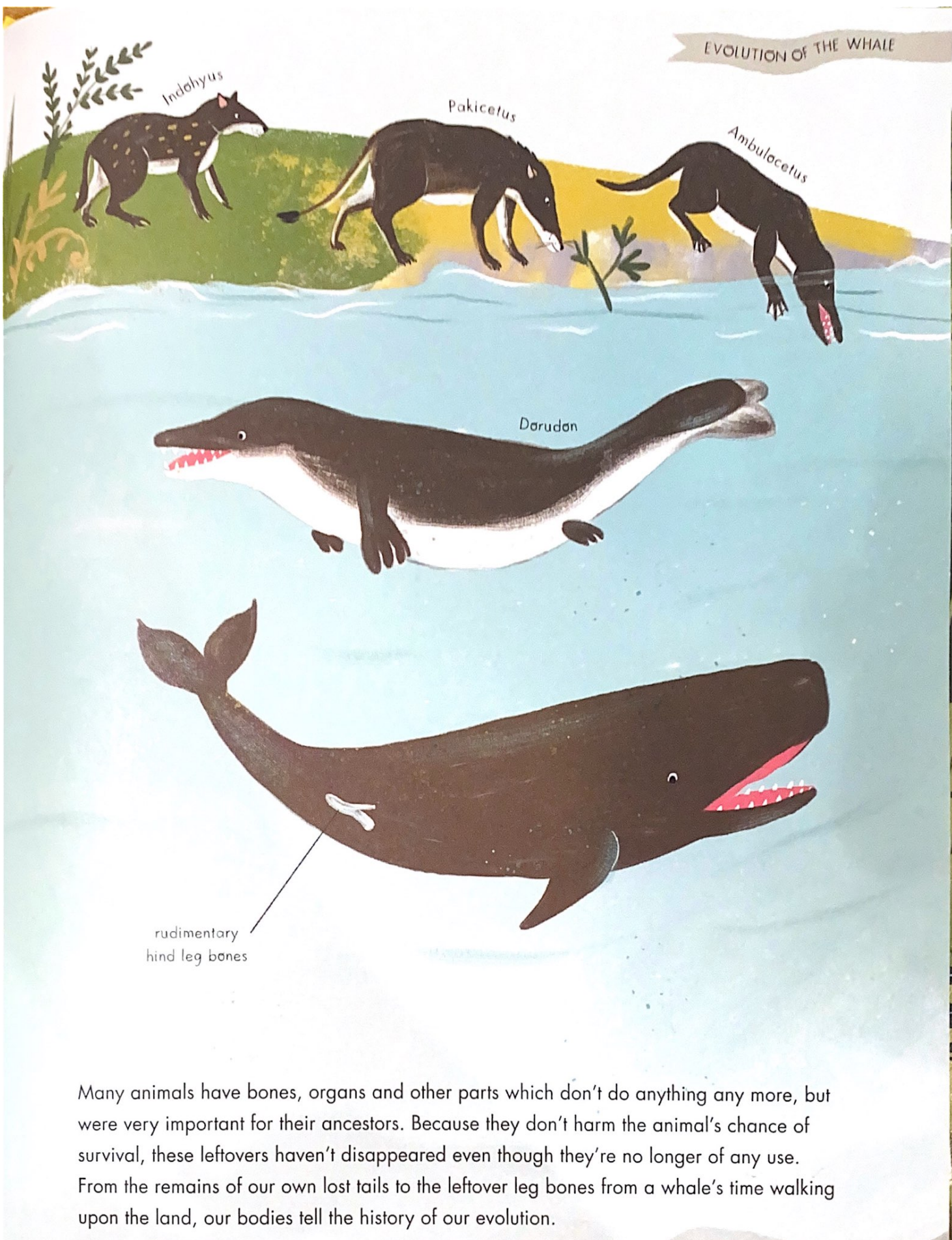
HUMAN EMBRYO



Before any animal is born or hatched, it is a tiny being called an embryo. At the very first stages, some embryos are quite difficult to tell apart. These similarities go to show that all animals are related at some level. Each creature has evolved its own different features based on the same basic blueprint for a creature's beginnings here on Earth.

* See Appendix VIII

EVOLUTION OF THE WHALE

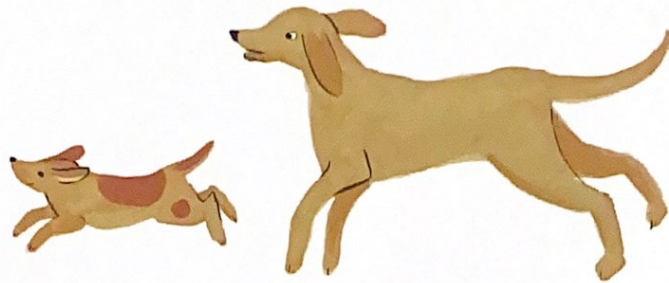


rudimentary hind leg bones

Many animals have bones, organs and other parts which don't do anything any more, but were very important for their ancestors. Because they don't harm the animal's chance of survival, these leftovers haven't disappeared even though they're no longer of any use. From the remains of our own lost tails to the leftover leg bones from a whale's time walking upon the land, our bodies tell the history of our evolution.



*"In the distant future I see open fields
for far more important researches . . .
Light will be thrown on the origin of
man and his history."*



Conclusion

Darwin's Theory of Evolution by Natural Selection:



1.

All living things are born with slight variations or differences.

2.

Some differences help with survival and having babies, and are passed down through generations.



3.

Many species have lots of babies, some of which will not survive.



4.

Those that survive are better adapted to living and breeding in that environment.



5.

Useful traits that can be passed down through generations will become more common in the population, eventually leading to evolution.



Darwin's book comes to an end, but the process of evolution keeps going. For as long as the cycle of life goes on, we will adapt and evolve alongside our fellow animals and plants, here on planet Earth.