

Natural Selection



Man: A Course of Study

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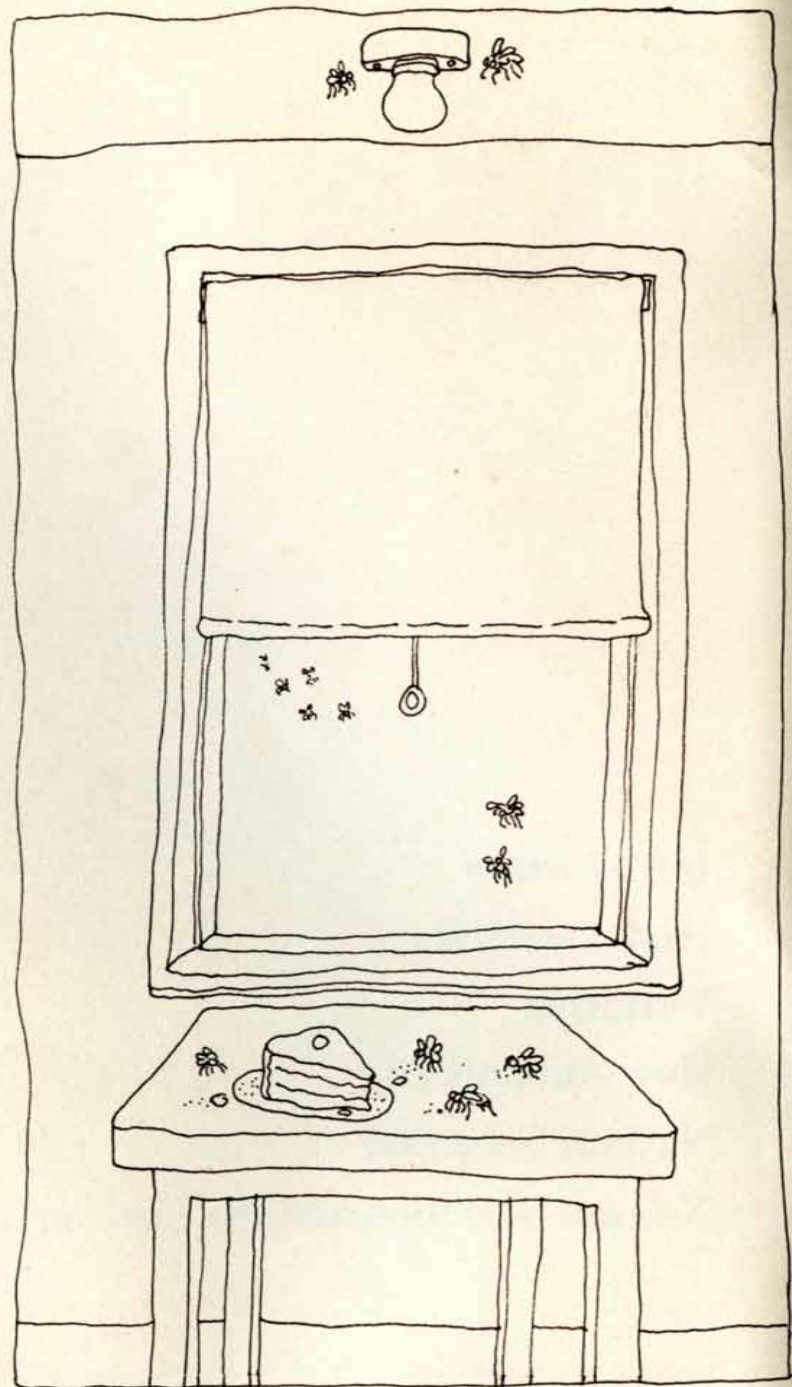
Natural Selection

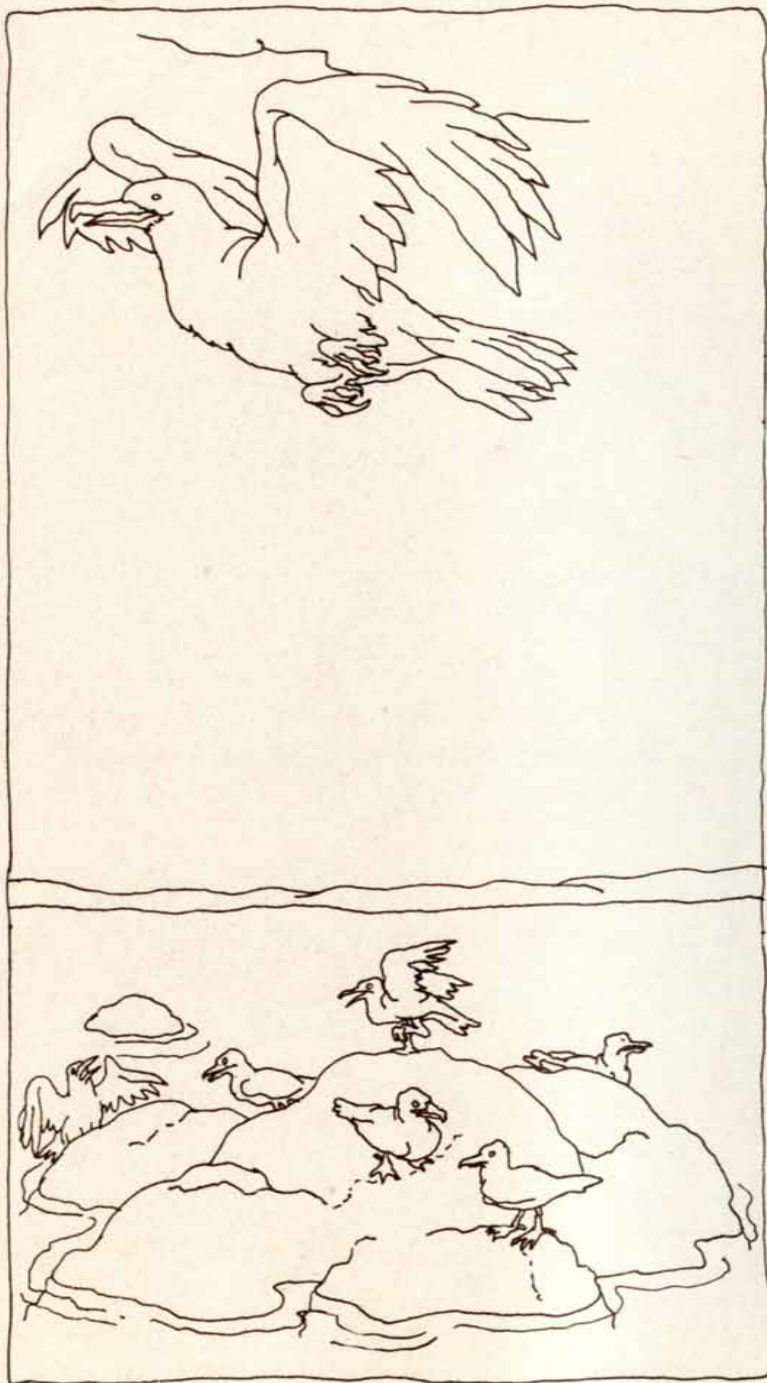
Illustrated by Arielle Mather

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Some scientists believe that

All the different animals in the world today are like they are because of natural selection. Natural selection has brought about the baboon and the herring gull, the house fly and the hippopotamus. To understand the many different animals of this world, we must understand what natural selection is and how it works.

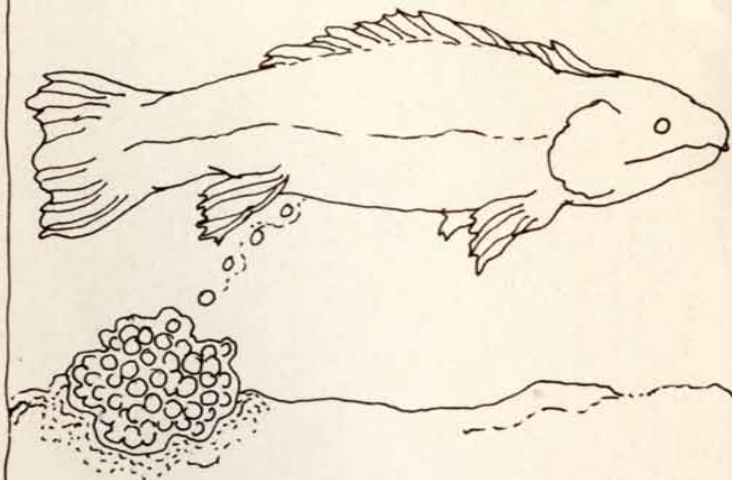




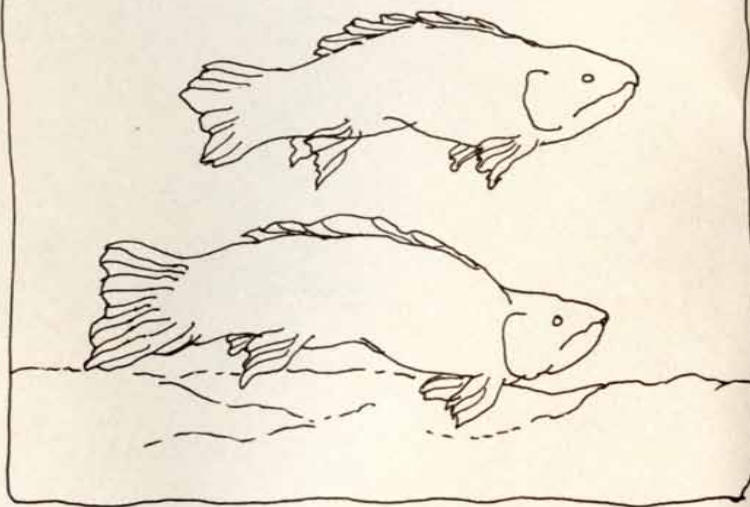
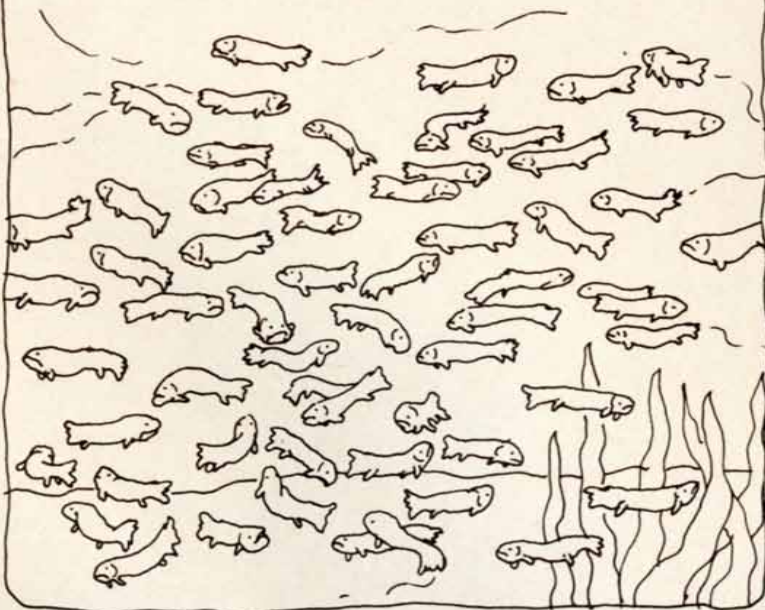
High Death Rate

In all species more animals are born every year than can survive to reproduce. In fact, most animals die before they reproduce.

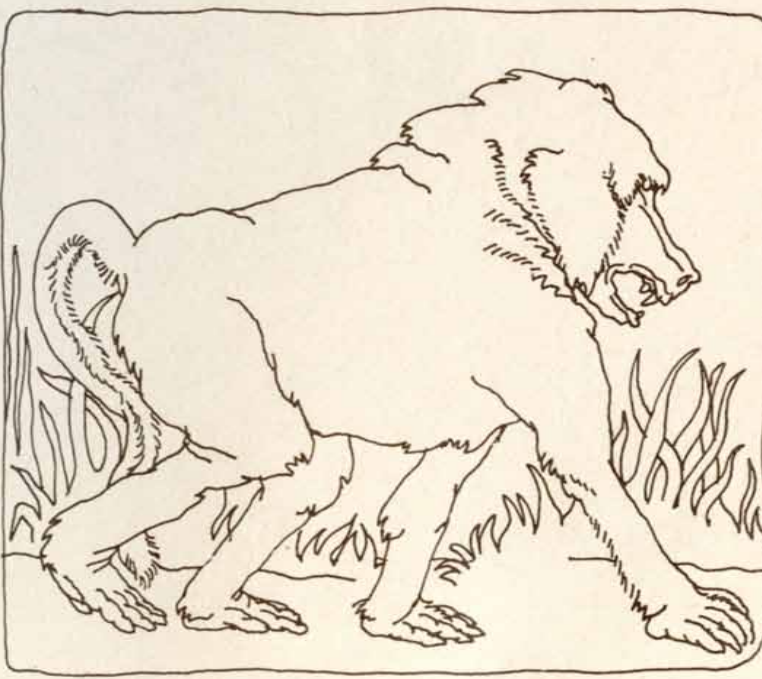
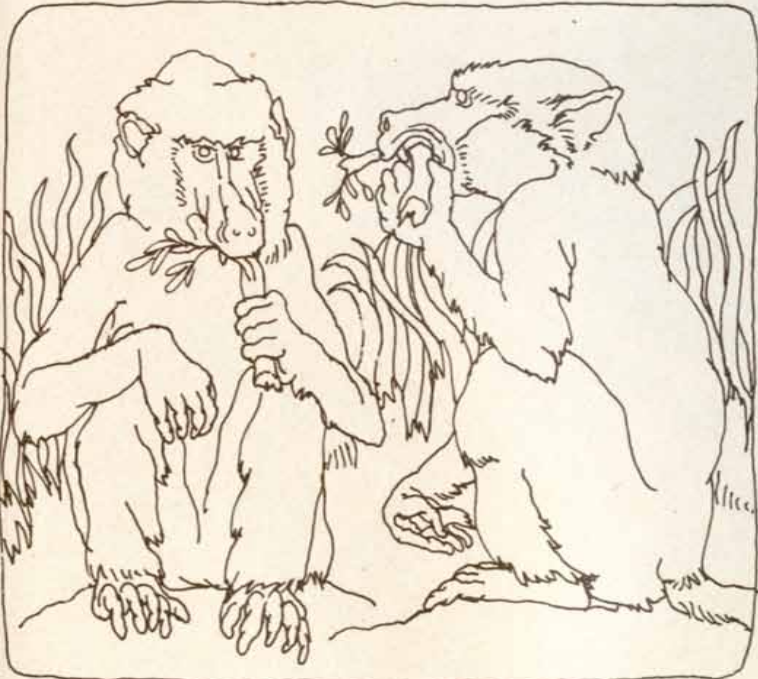
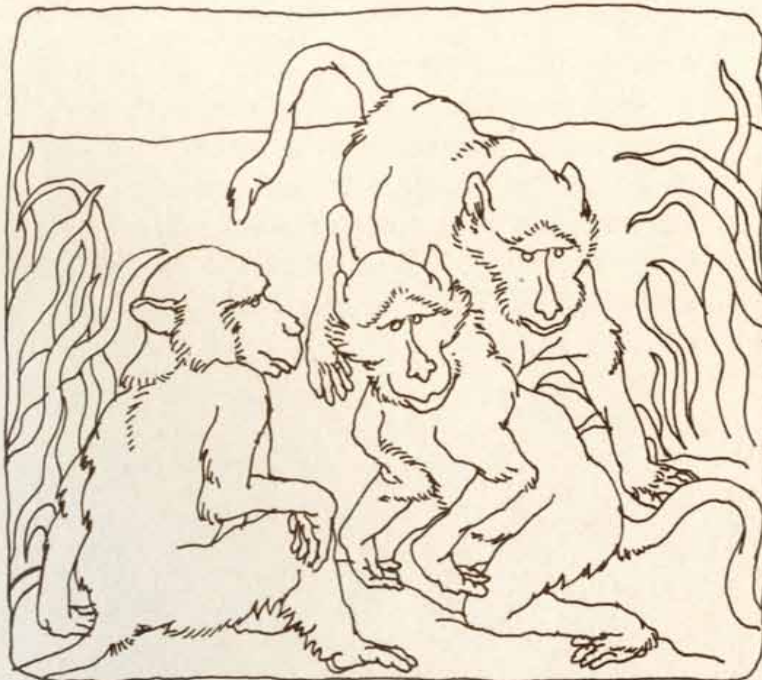
Of the 6,000 eggs a salmon lays,



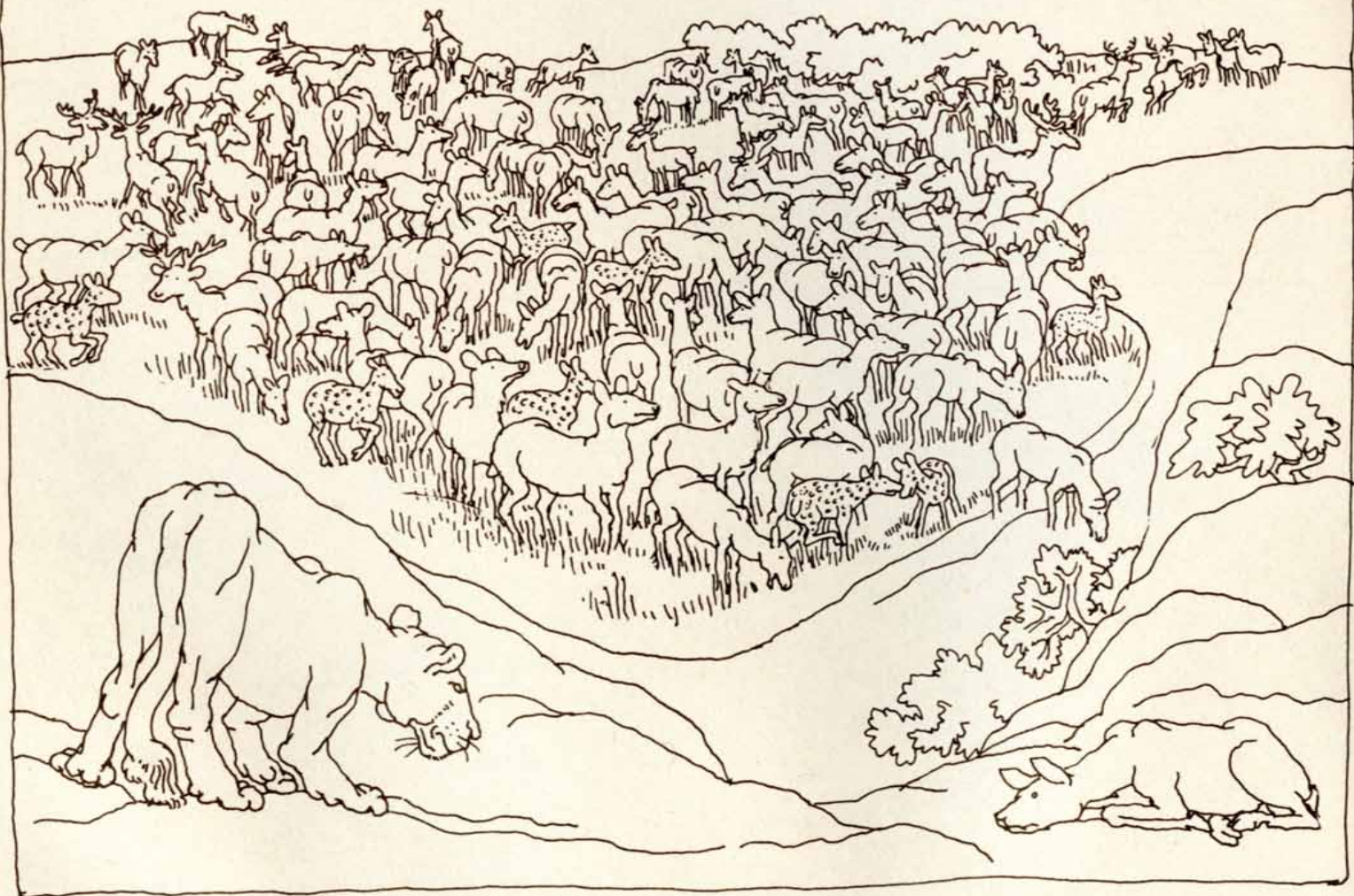
only about two fish survive to reproduce.



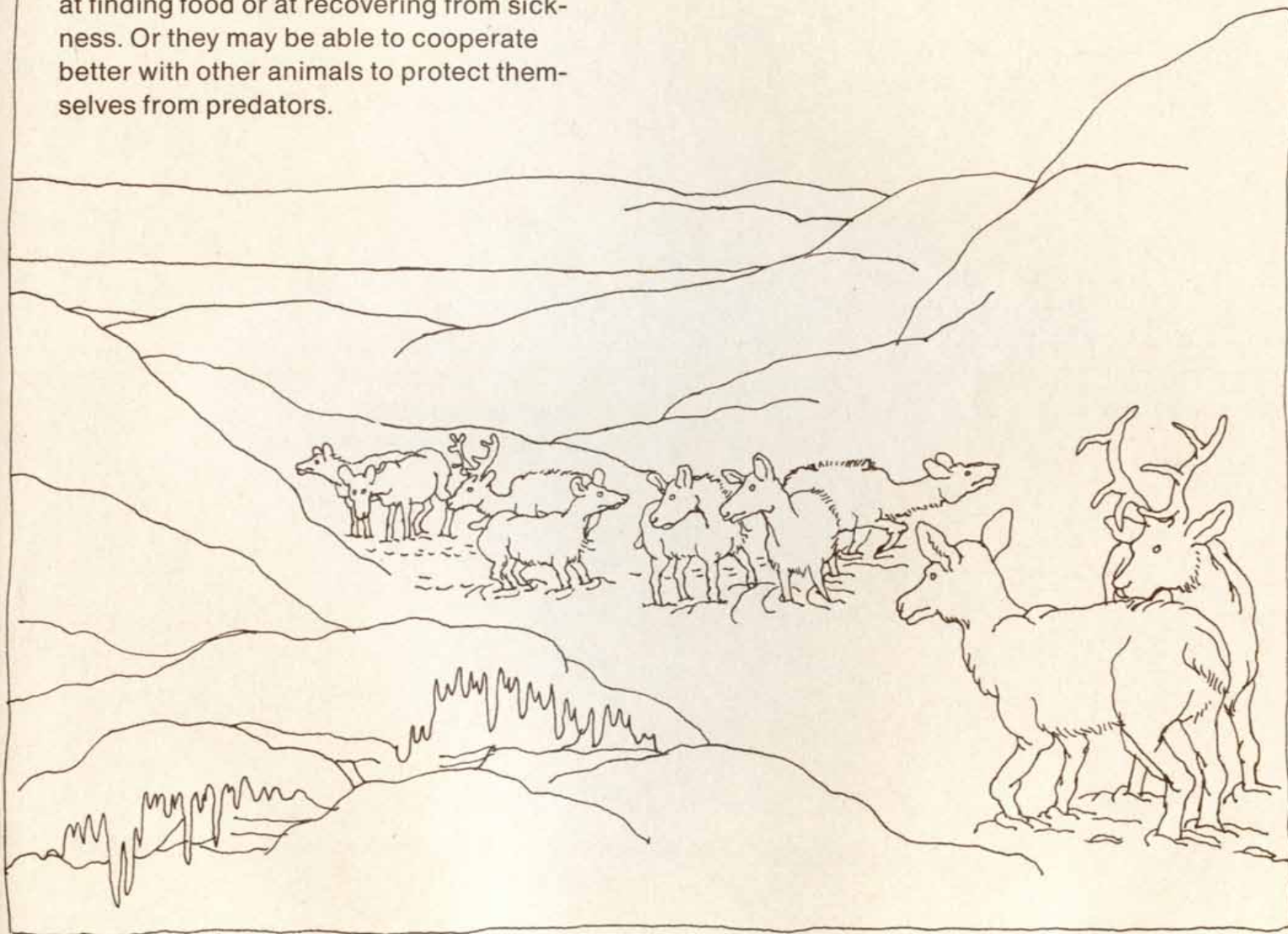
Two out of every three baboons die before they are five years old.



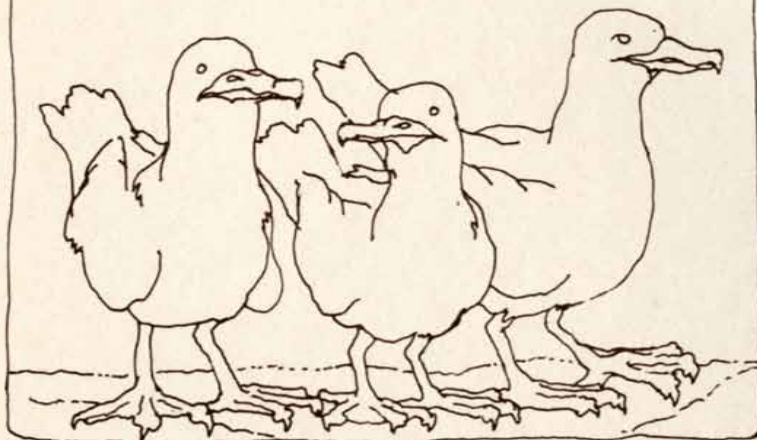
Animals usually die because they cannot get enough food, or because they get sick, or because they are eaten by a predator. Often, they die for several reasons at once. For example, an animal weakened by hunger is more likely to get sick. And a sick animal is more likely to be eaten by a predator.



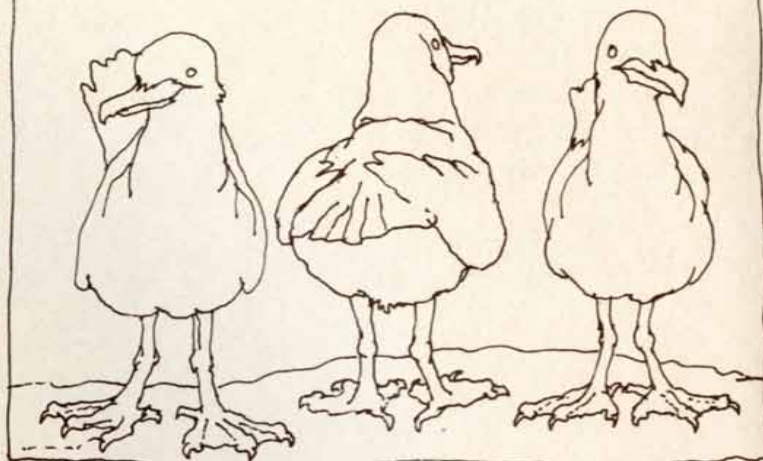
This high death rate means that it is very difficult just to stay alive. The animals that do survive are usually those that are born with structures and behaviors that help them survive. They may be especially good at finding food or at recovering from sickness. Or they may be able to cooperate better with other animals to protect themselves from predators.



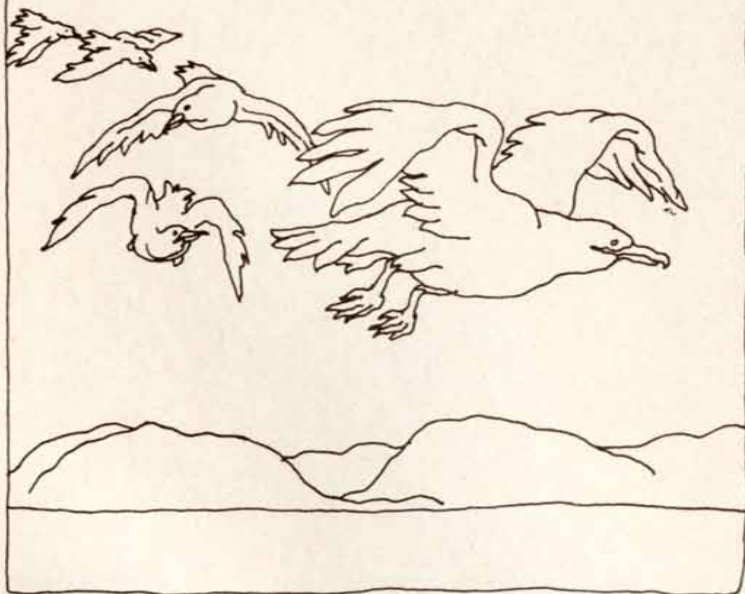
There is great **variation** among the members of any species. That is, a member of any species is different from other members of the same species. Some herring gulls are taller than others,



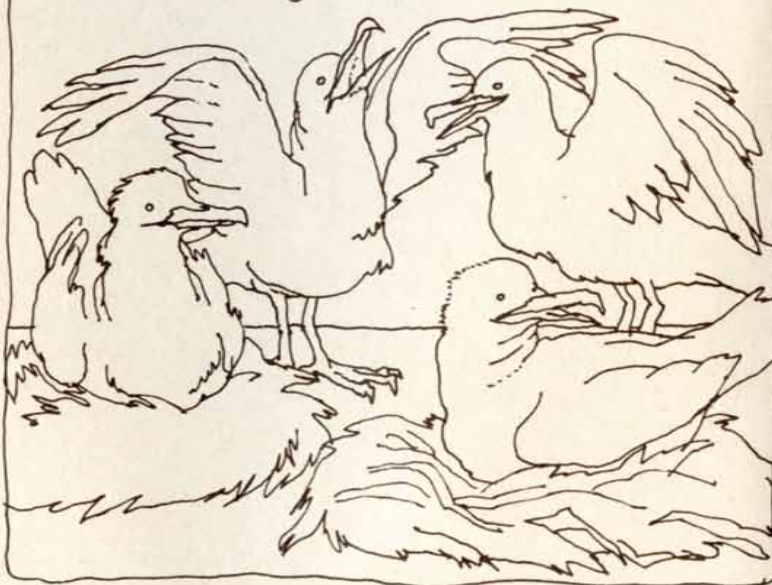
some are fatter,



some fly faster,

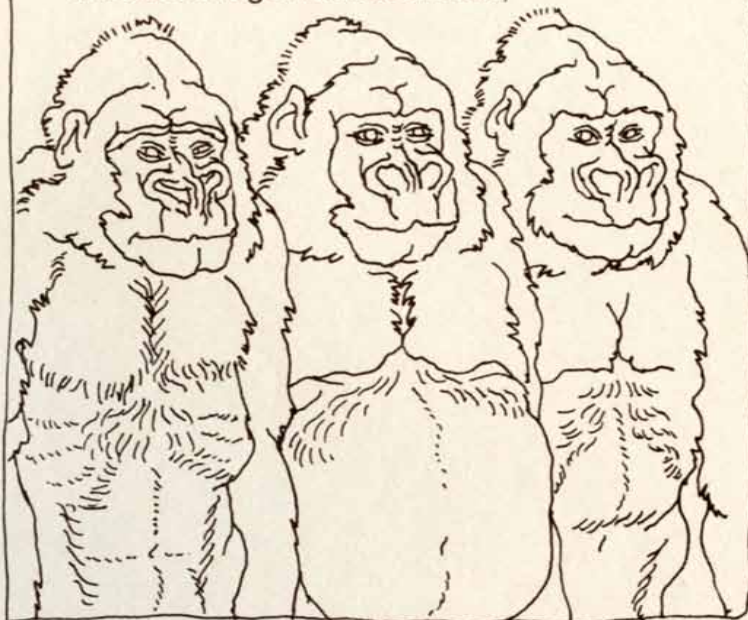


some are quieter,
some have longer feathers.



**In every characteristic of every species
there is variation.** There is variation in . . .

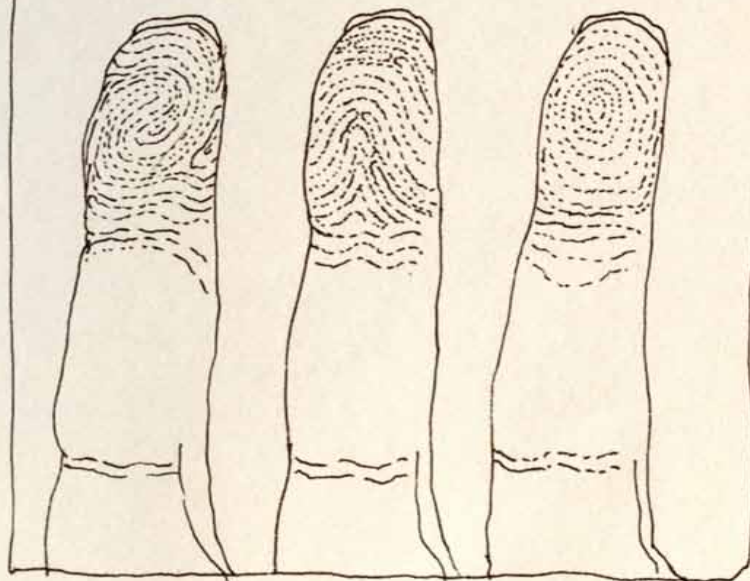
the size of a gorilla's stomach,



how much baboons are afraid of leopards,



the human fingerprint .

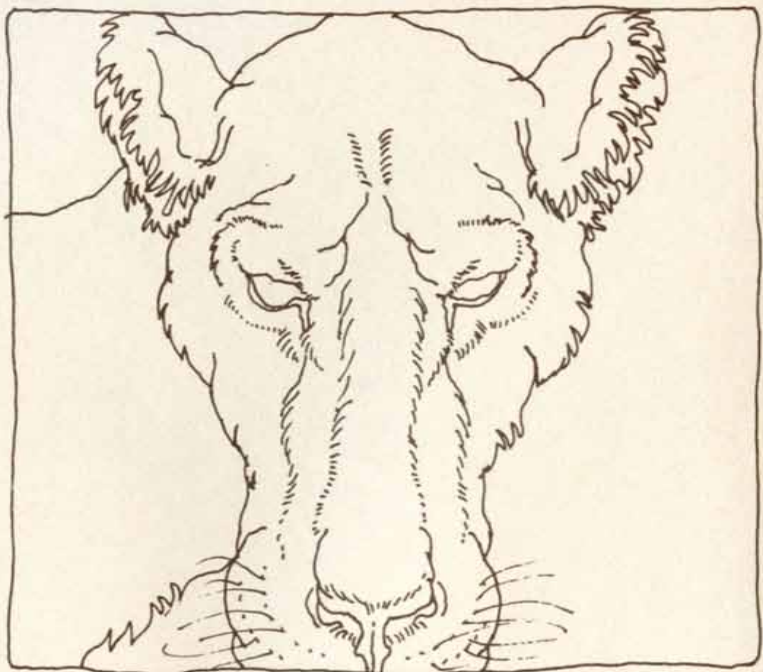
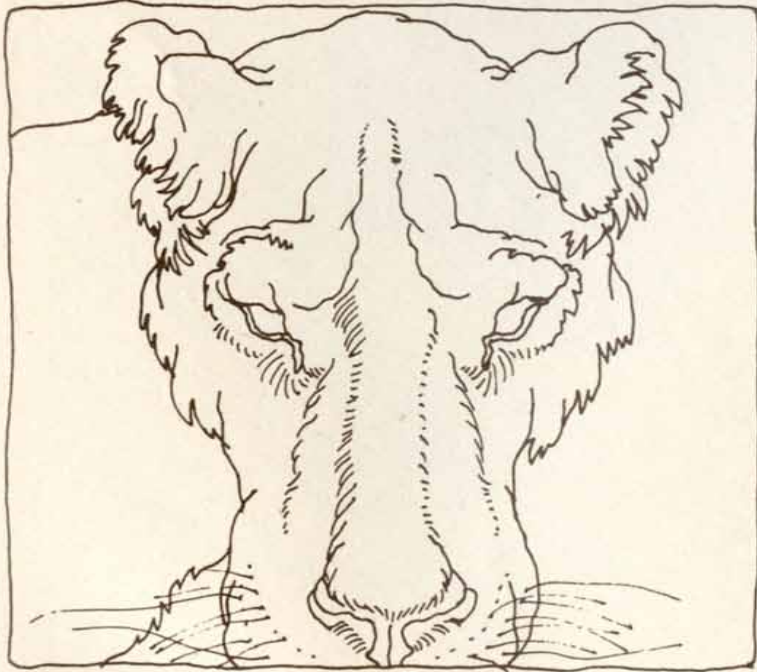
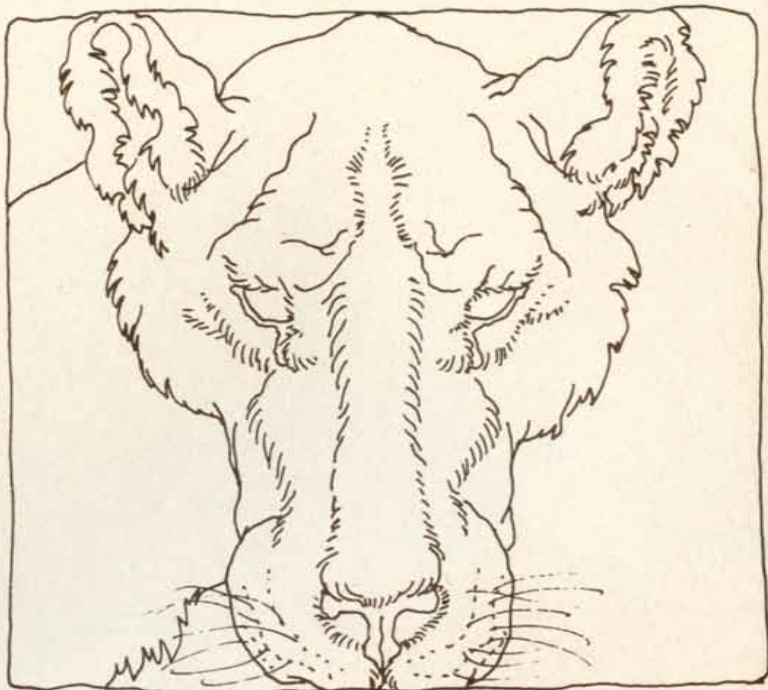


When we look carefully at one species we can see how much the members vary. It is easy to see that lions differ in body size and in fur color.

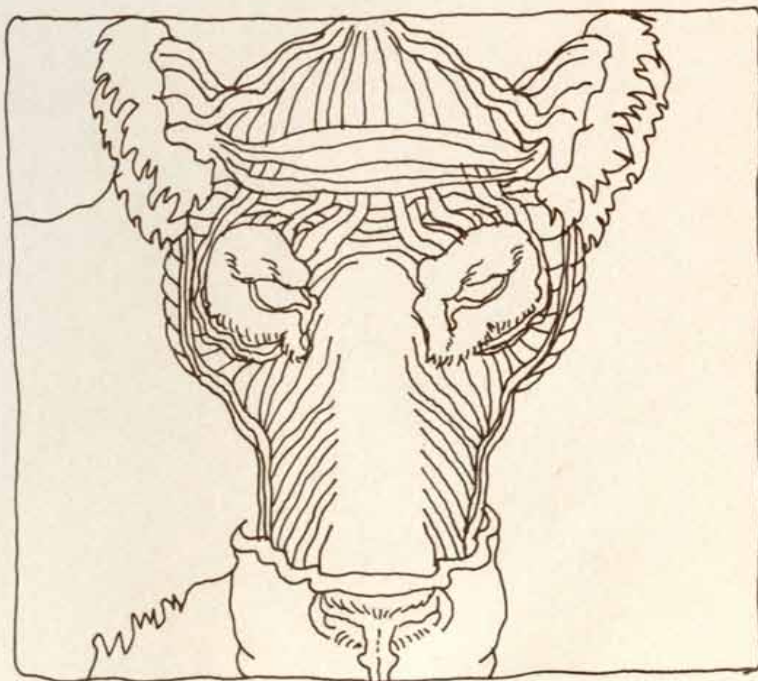
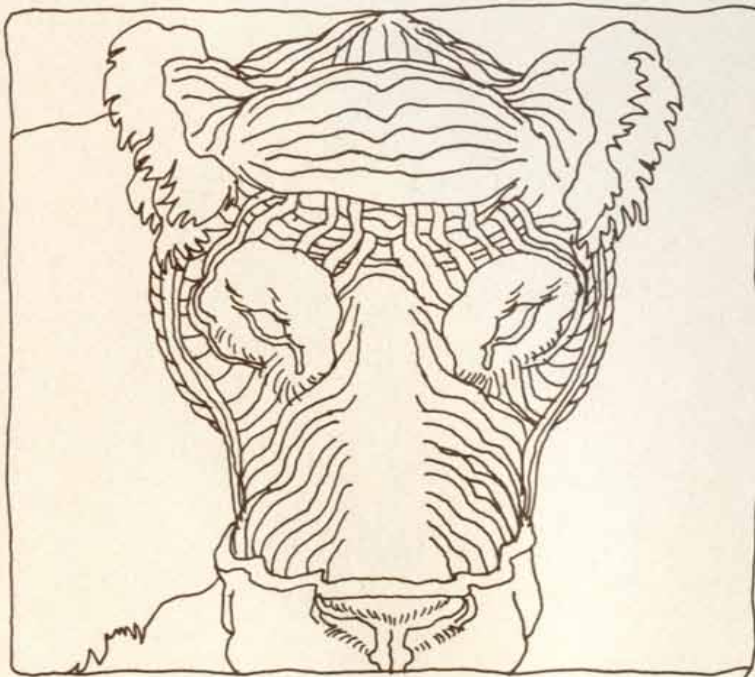
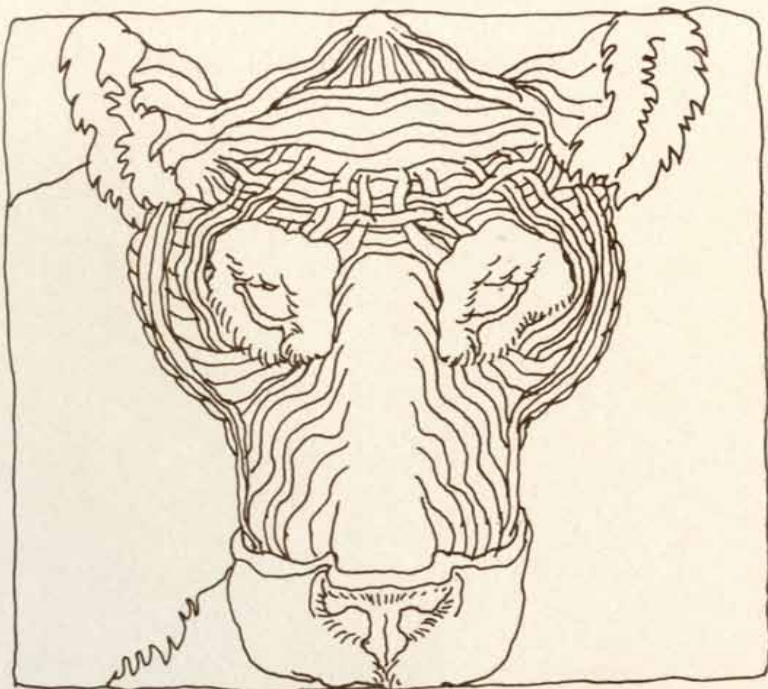




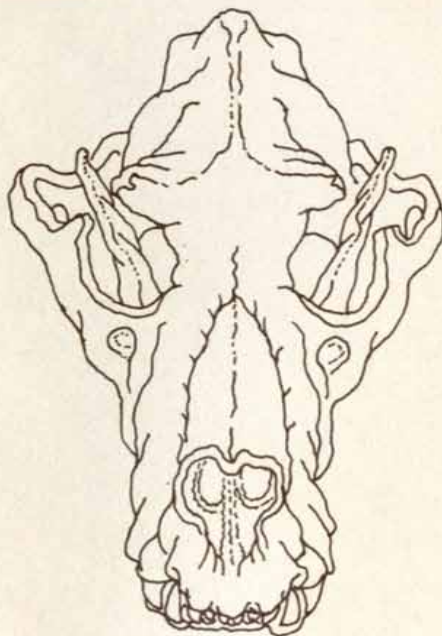
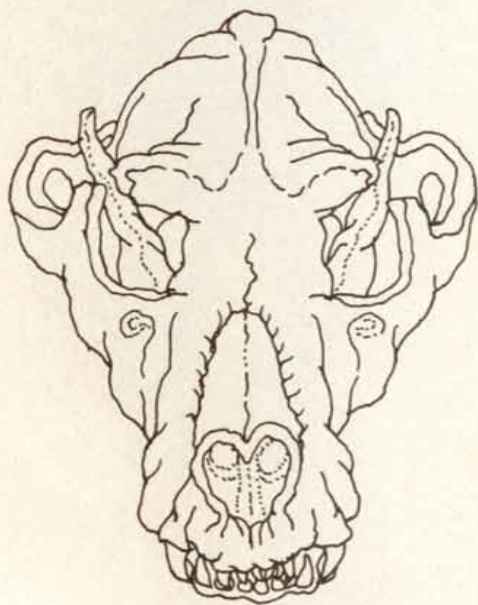
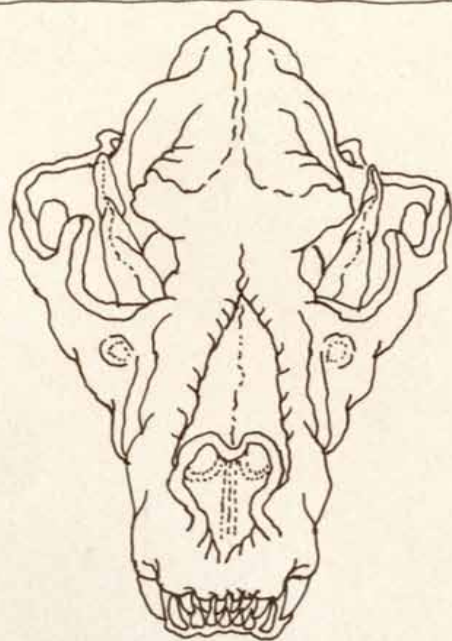
But when we look more carefully we find that they also differ in the pattern of fur of the head, in the length and shape of ears and in the shape of the mouth.



Under the skin, they vary in the size and shape of the muscles.

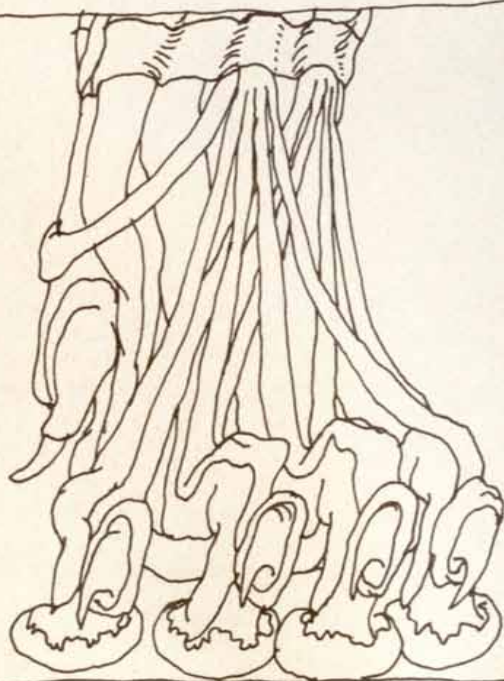


And under the muscles, they vary in the shape of the skull bones.

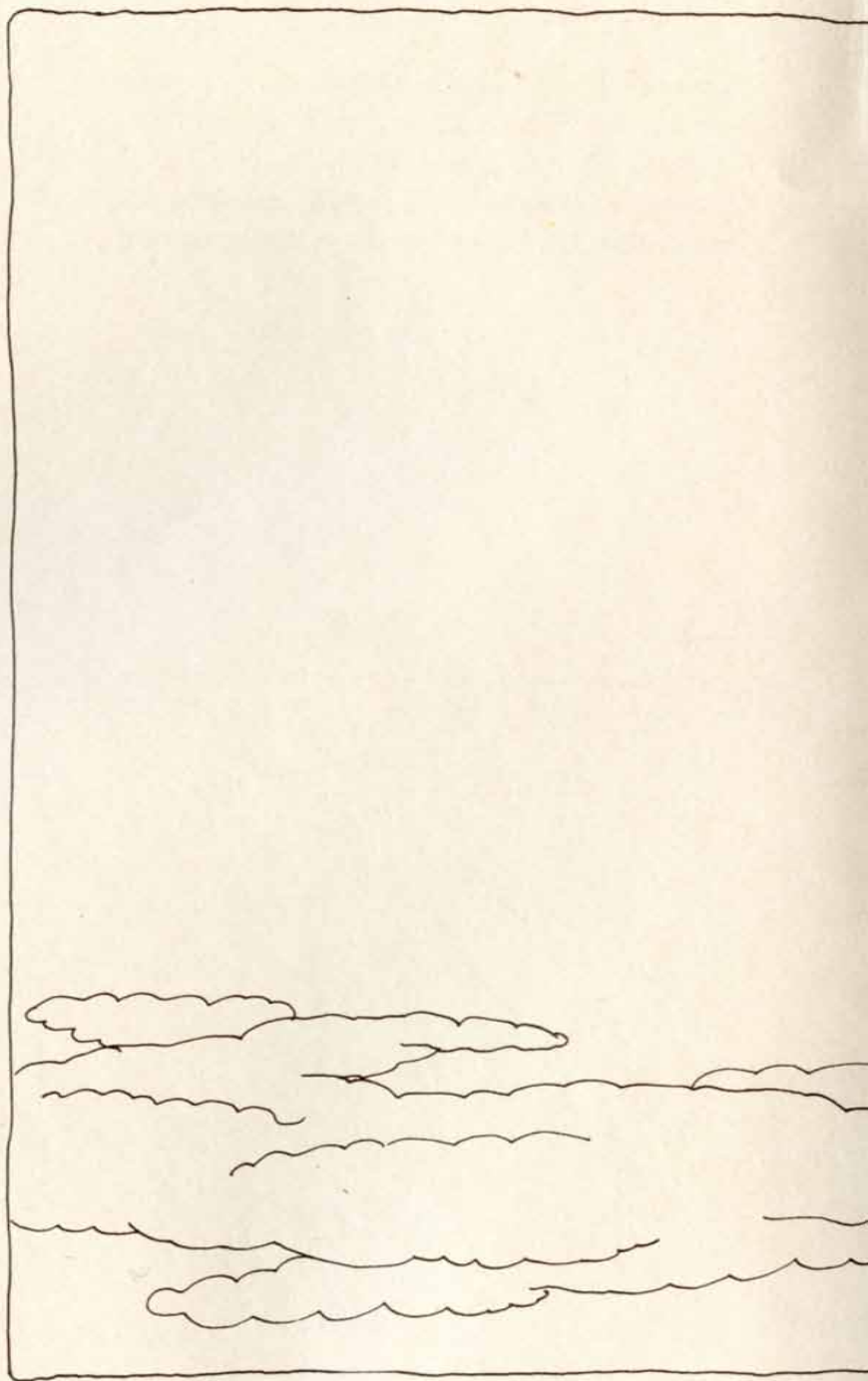


The same variation can be found anywhere on the lion. For example, there is variation in every characteristic of the lion's foot.

These variations may be slight, but they can make the difference between life and death.



It is very difficult to find out **how animals die**. Most animals die very quickly, without a human observer. But sometimes we know how animals die, and this helps us understand how natural selection works.





Gustaf Rudebeck watched hawks for many years in Sweden. He sometimes saw successful hunts. Once he saw the following:

A sparrow hawk was flying quite low over a field. Suddenly it turned around and landed. Two starlings flew up where the hawk landed. After some minutes the hawk arose with a starling in its claws.

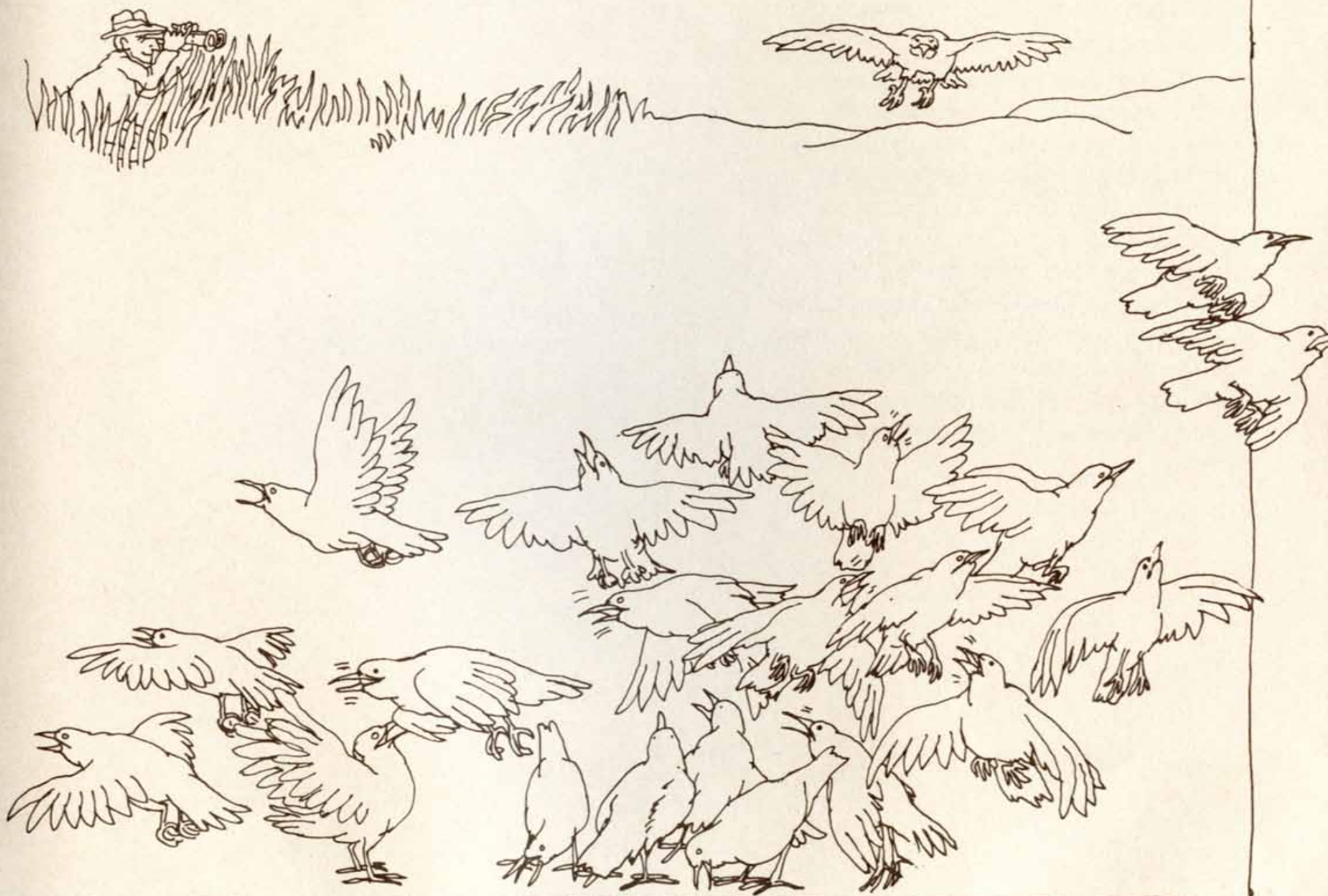
Rudebeck believes that the starling was caught because it was in such a small flock:

This was a surprise attack from a short distance. The sparrow hawk was flying low but did not otherwise sneak up. It noticed the starlings rather late, but before any one of the three birds noticed the danger. The flock of only three starlings was very small. The sparrow hawk probably appeared at a moment when all three starlings happened to be in such a position that they did not notice the danger. Larger flocks would almost certainly have noticed the danger.

Note: This example is adapted from an article by Gustaf Rudebeck called "The Choice of Prey and Modes of Hunting of Predatory Birds, with Special Reference to Their Selective Effect." (*Oikos*, vol. 2, 1950, pages 65-86.)

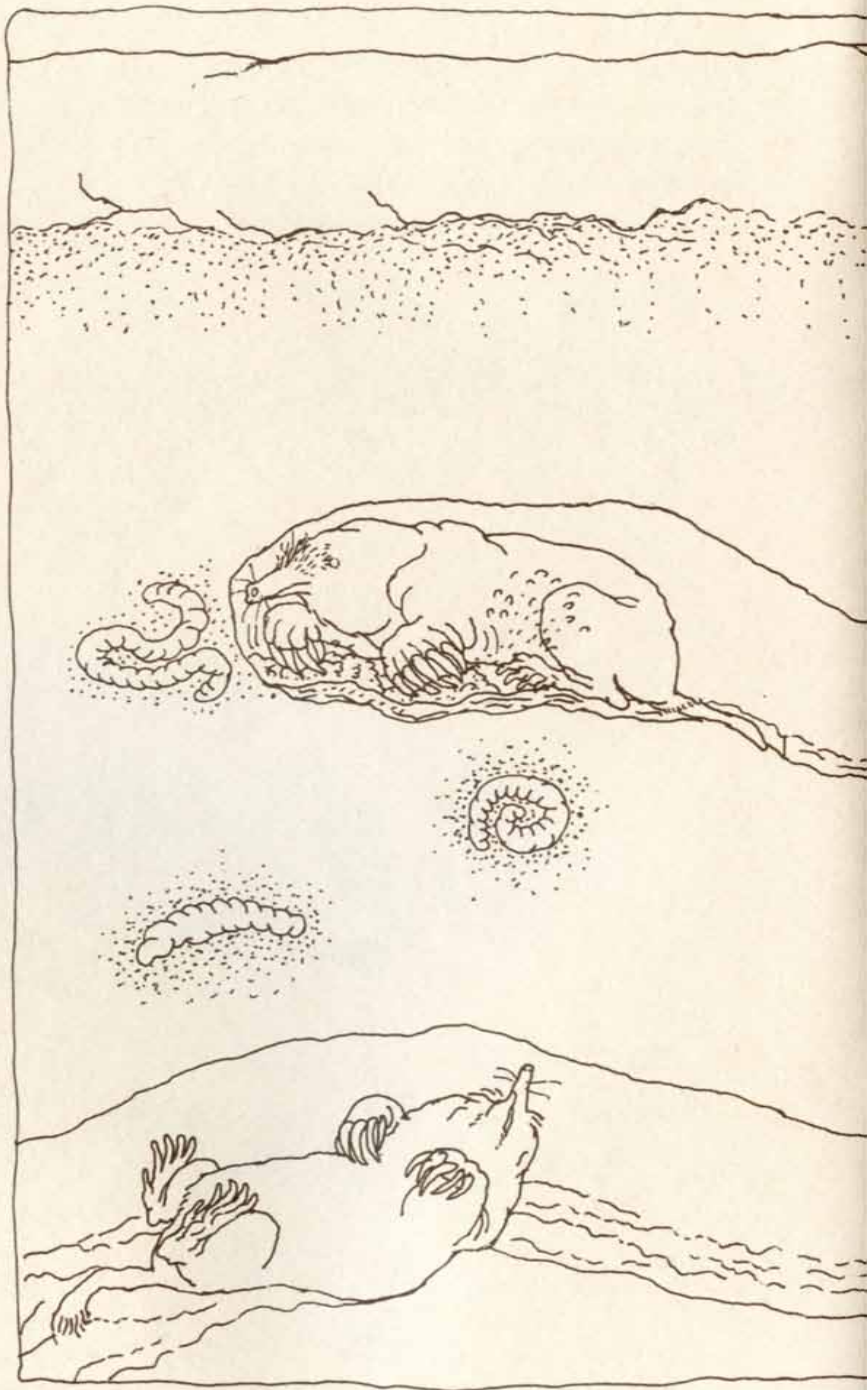


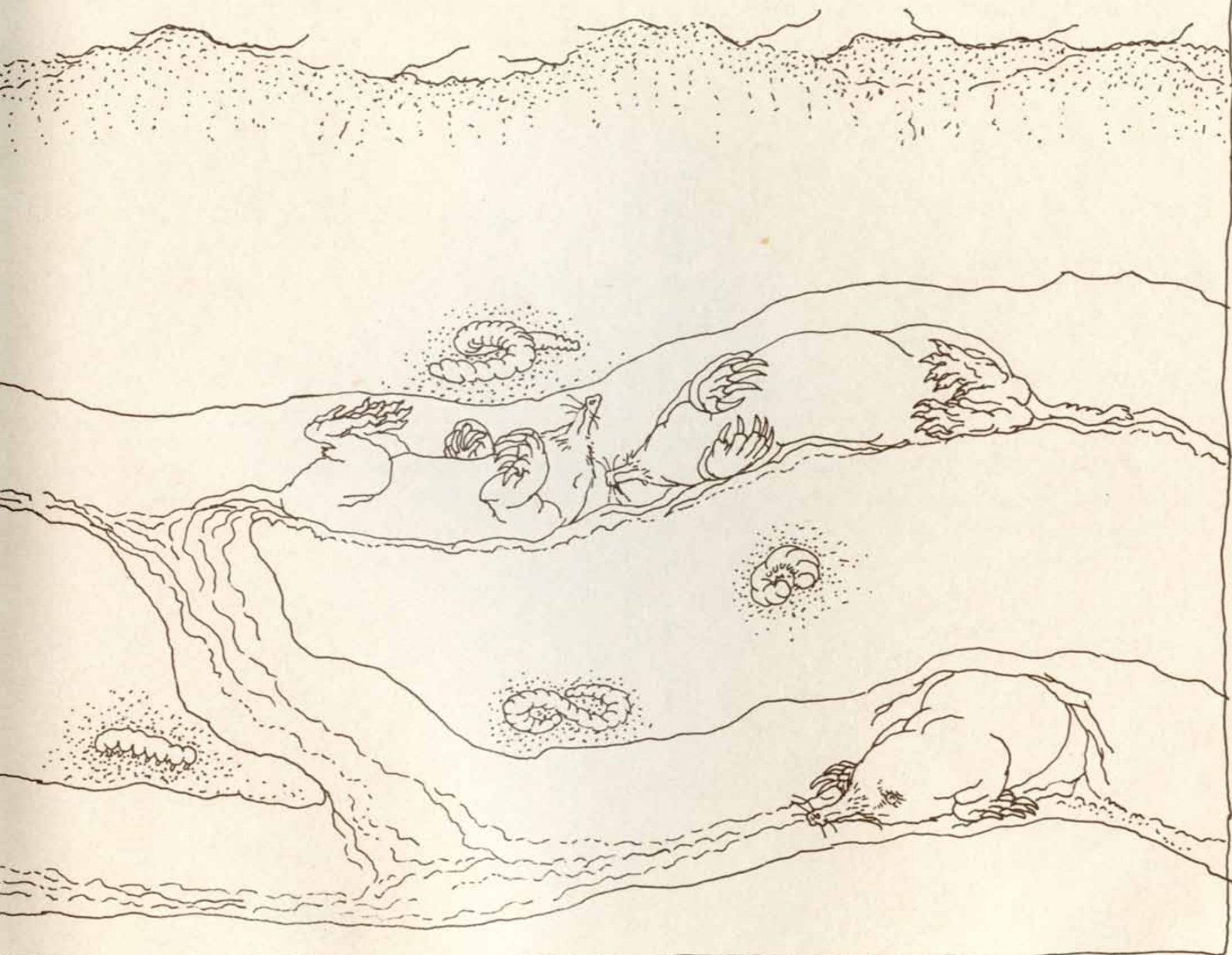
In this case, natural selection favored
starlings that preferred to be in large groups.
The starlings that survive have offspring.
The offspring will tend to be like their
parents and will live in large groups.



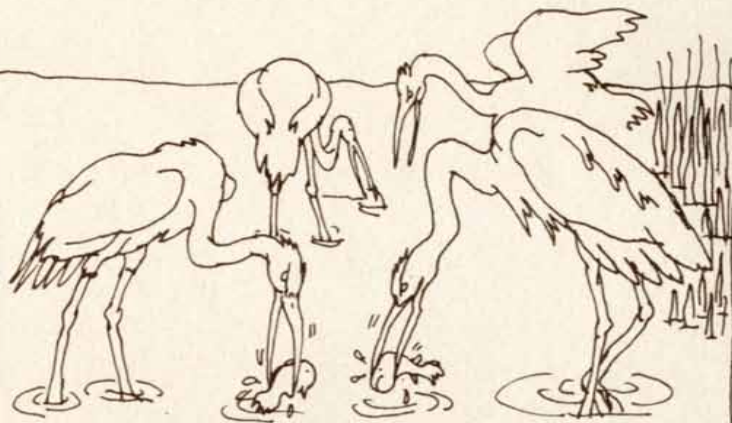
The winter of 1946-1947 in Europe was very cold. The ground was frozen solid for more than three months. The moles of Europe died at an especially high rate because they could not dig for their usual food in the frozen ground. Probably fewer than one out of every hundred moles survived the winter.

Herr Stein studied the moles and found that smaller moles survived the winter best. He believed the small moles were able to survive more easily when there was not much food, because they did not need much food. Larger animals that needed more food could not find it. As a result, more of them died of starvation. In this case, natural selection favored small size. It was the smaller moles that had offspring, and in the next generation most of the moles tended to be small like their parents.

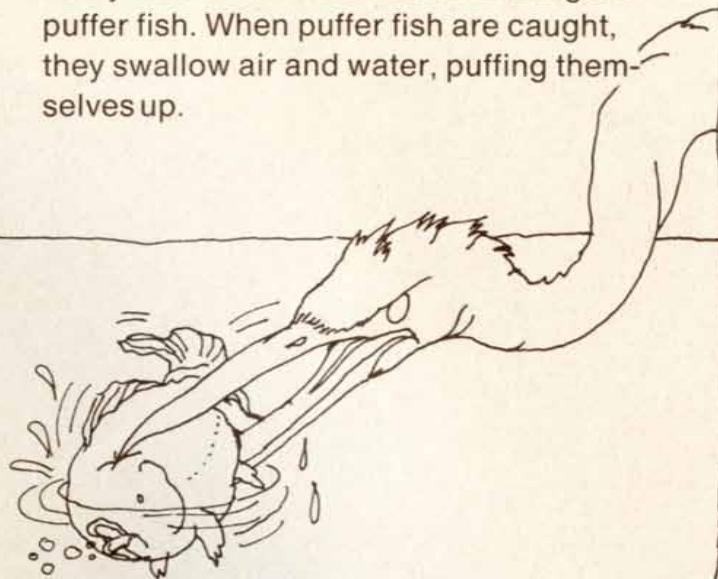




Natural selection works on both predators and prey. It favors prey that can escape from predators, and it also favors predators that are good at catching prey.



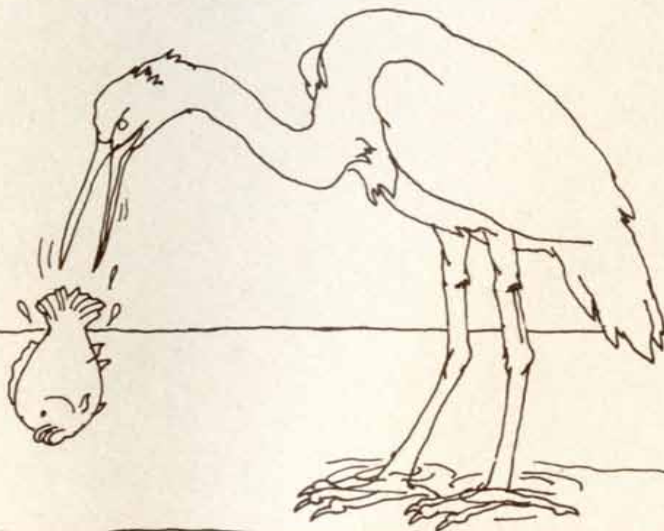
Harry Recher studied herons feeding on puffer fish. When puffer fish are caught, they swallow air and water, puffing themselves up.



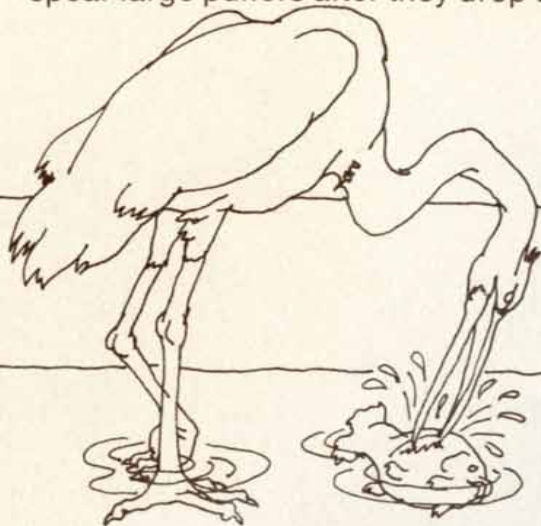
Herons can swallow small puffers,



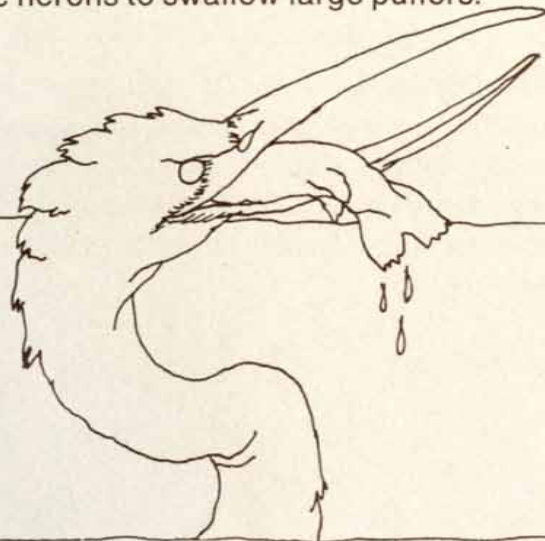
but they cannot swallow large puffers so they drop them.



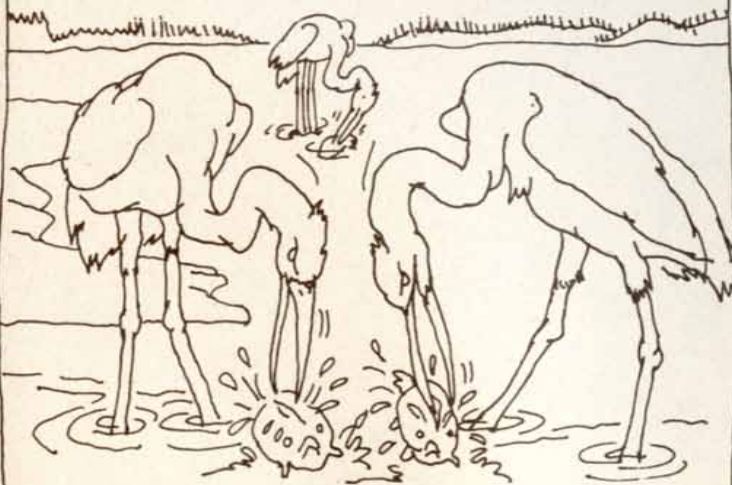
Some herons, however, have learned to spear large puffers after they drop them.



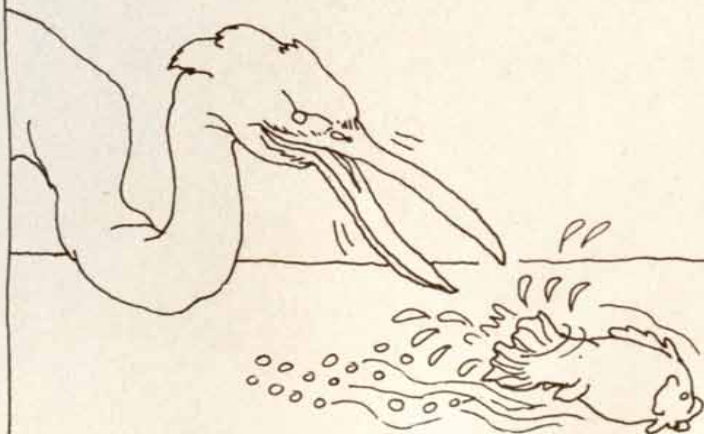
This is like popping a balloon, and it allows the herons to swallow large puffers.



Perhaps a few hundred years from now all herons will spear large puffers after they have caught and dropped them.



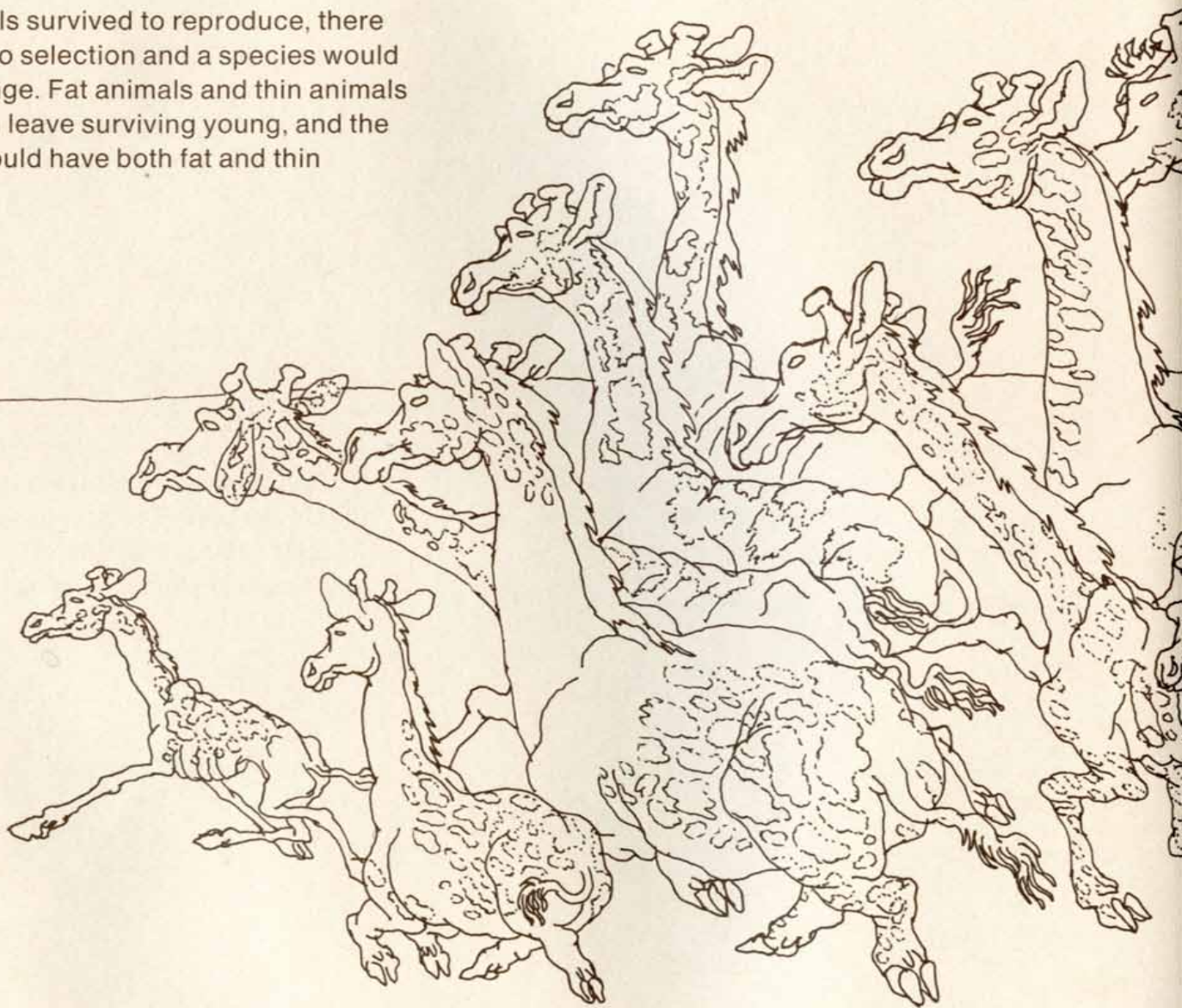
Natural selection will then strongly favor puffers that swim away rapidly after being dropped. Those that do will live and will produce fast-swimming offspring.



Natural selection depends on two things.

It depends on a high death rate, and it depends on variation within a species.

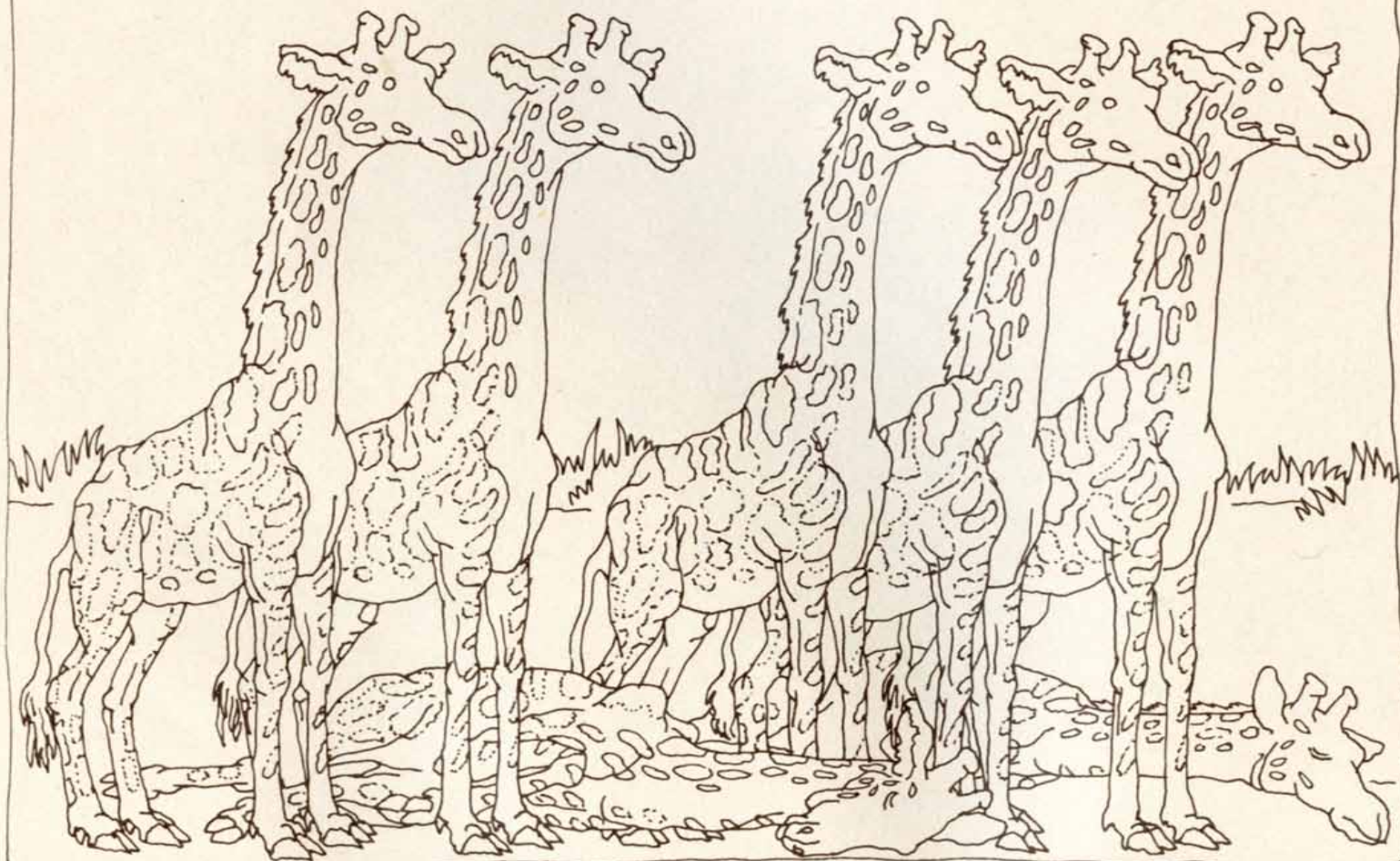
If all animals survived to reproduce, there would be no selection and a species would never change. Fat animals and thin animals would both leave surviving young, and the species would have both fat and thin animals.



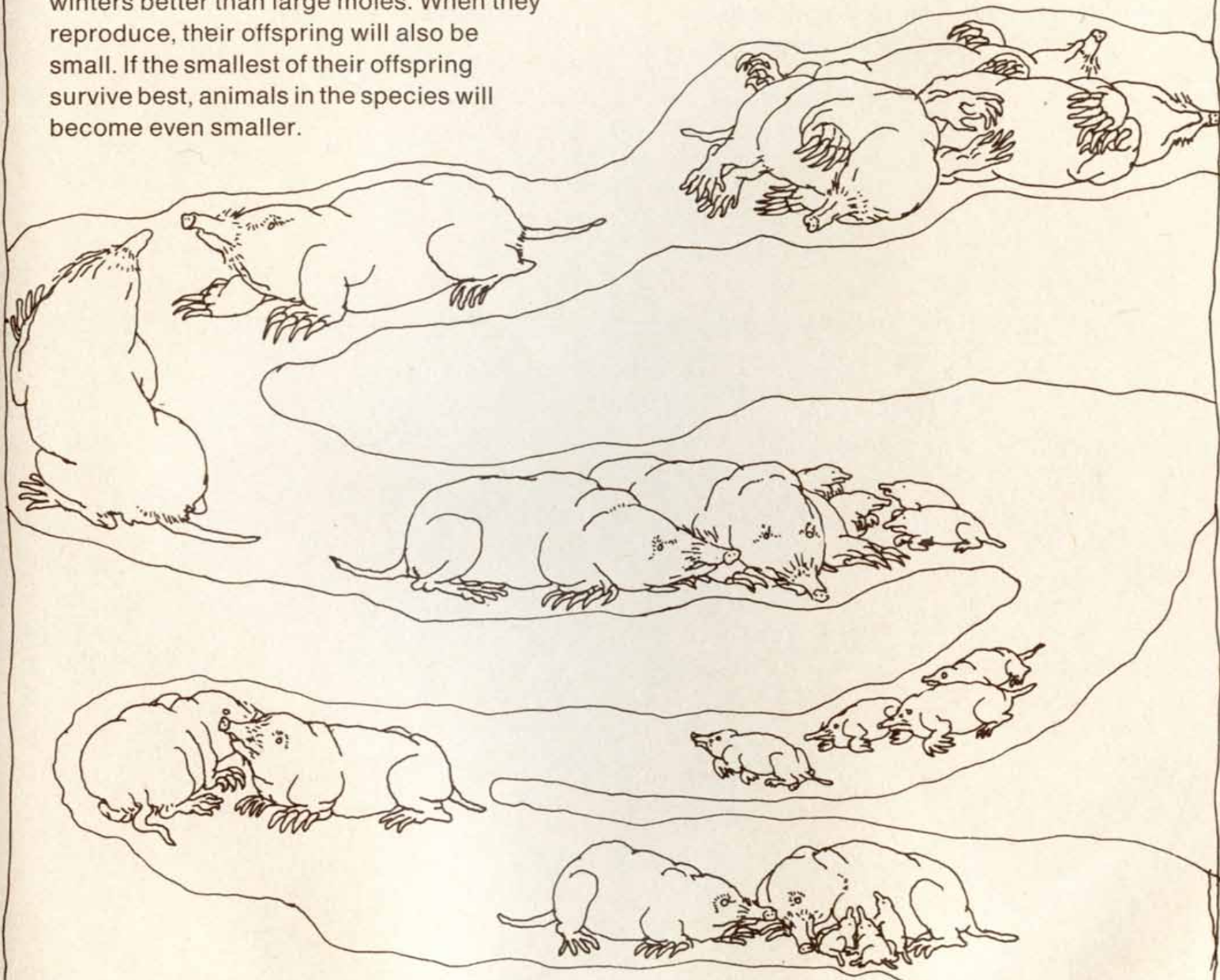


If there were no variation, natural selection could not work either. Then all animals in a species would be exactly alike, no matter which ones lived and which ones died.

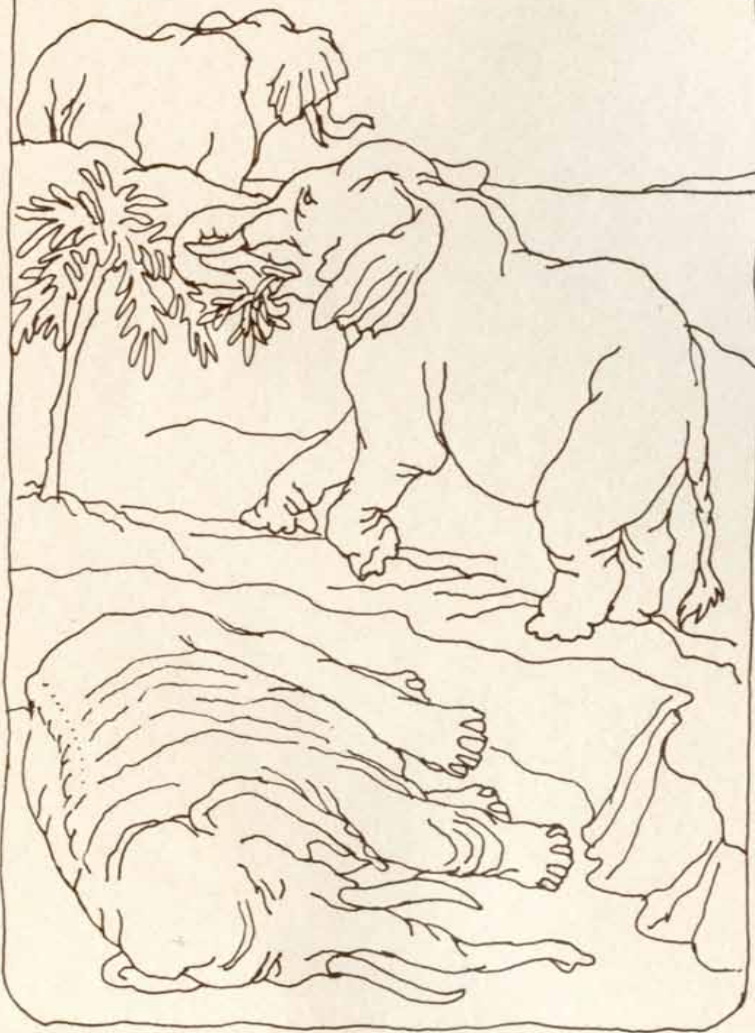
When there is variation and a high death rate, natural selection does work. Animals with some variations survive better than others, and these variations are the ones that will be passed on to the next generation.



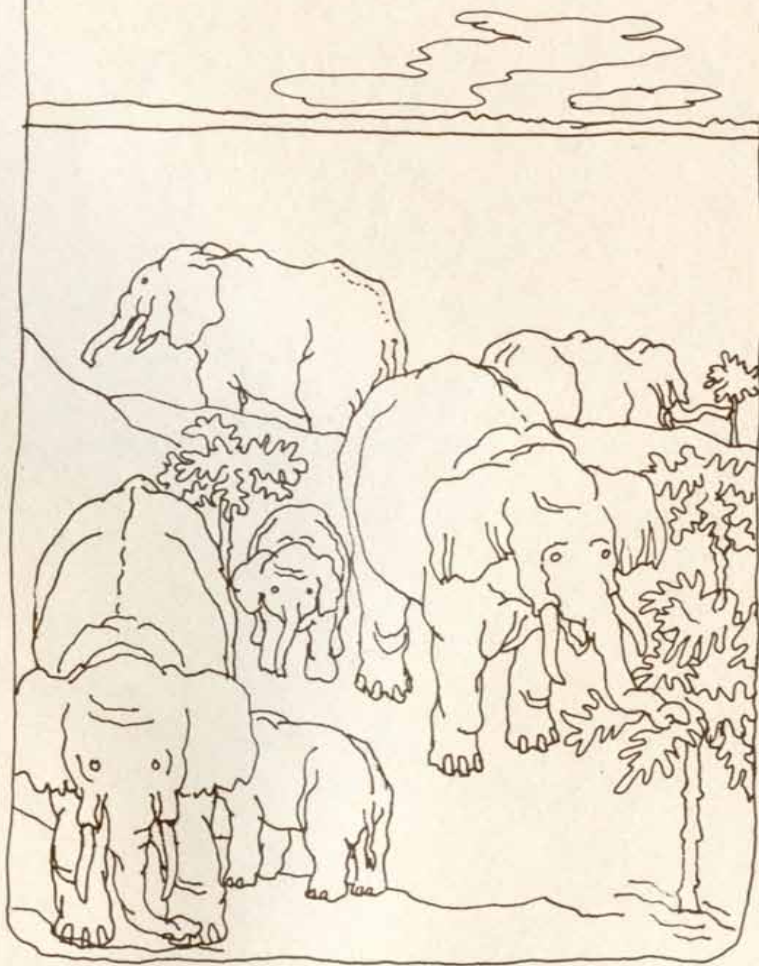
For example, small moles may survive cold winters better than large moles. When they reproduce, their offspring will also be small. If the smallest of their offspring survive best, animals in the species will become even smaller.



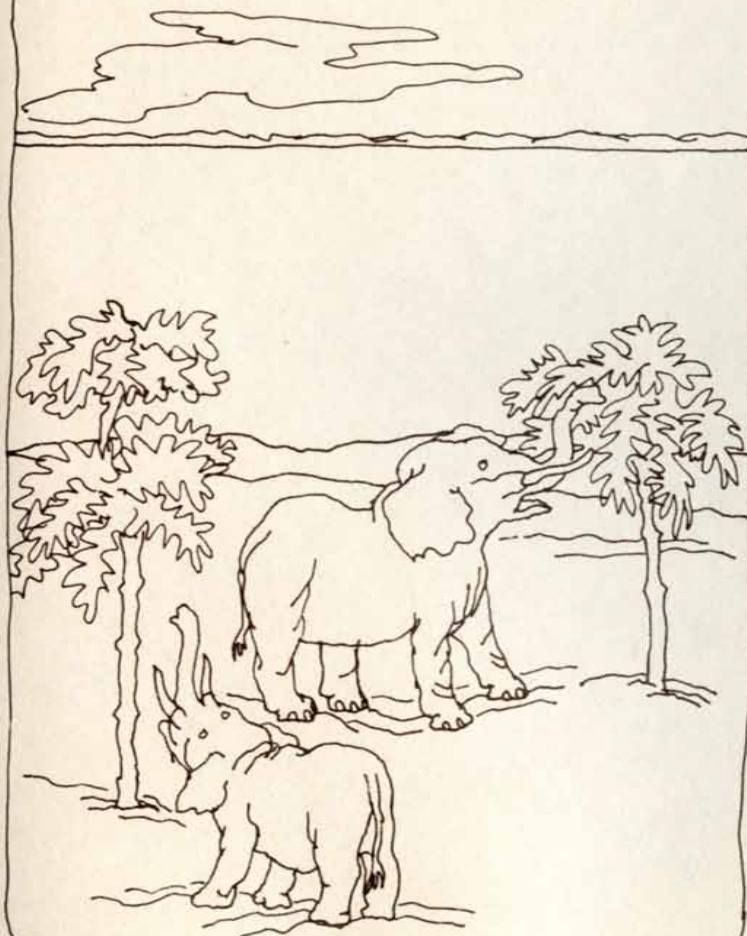
That is what happened to some elephants that landed on an island near Africa several million years ago. The smaller elephants survived better because they could live on less food.



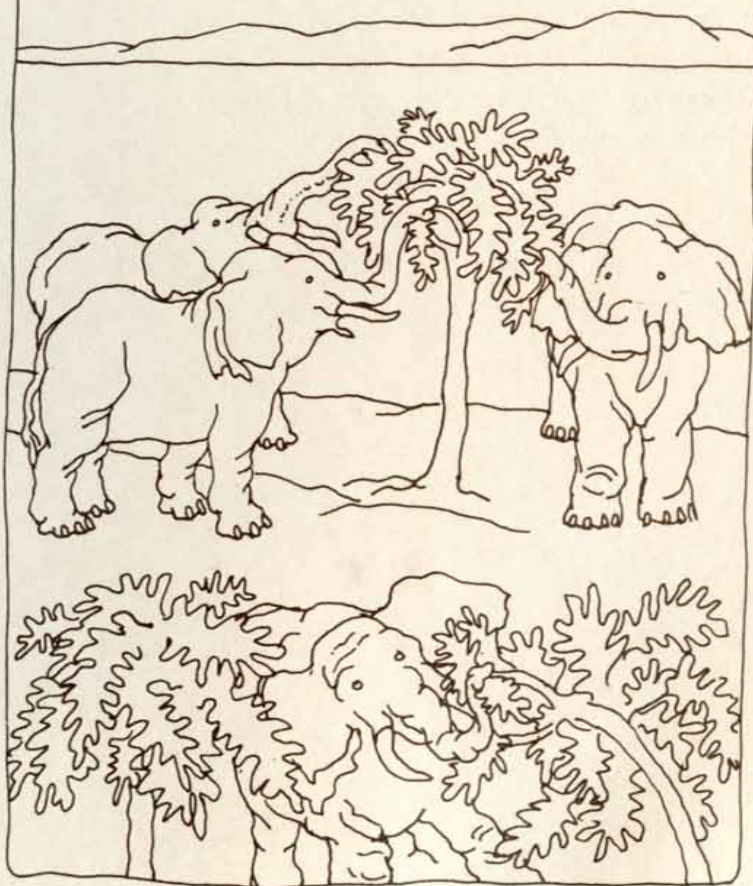
When they had offspring, the smallest offspring survived best because they needed even less food.



This went on for many years, until the elephant was the size of a large dog. At this size, it was no longer an advantage to be even smaller. An even smaller animal might have trouble reaching food, for example.



The medium-sized offspring survived better than the smallest offspring, and the species stayed the same size.



Natural Selection and the Environment

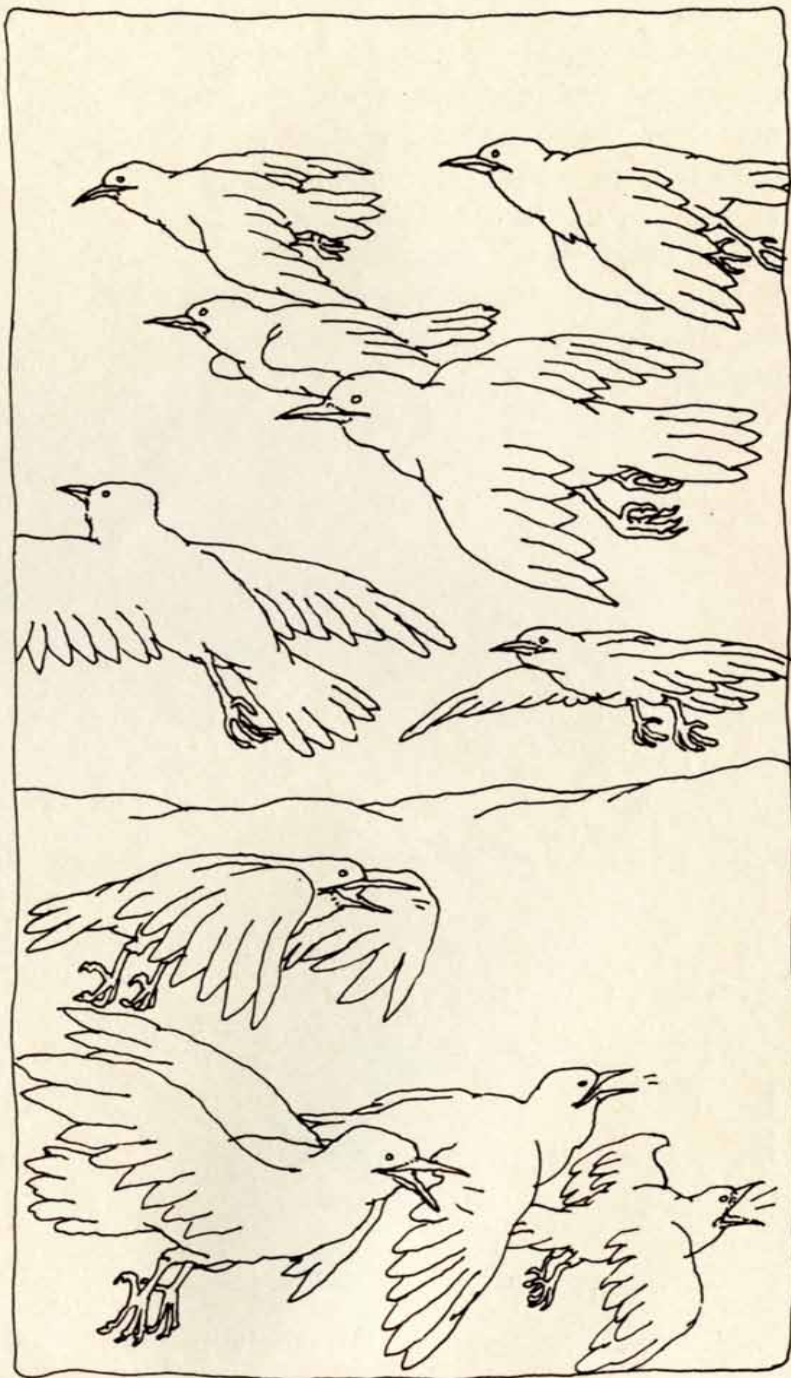
Natural selection favors different structures and behaviors in different environments, even if the environments are very much alike. Imagine two environments exactly the same except that in one there are sparrow hawks and in the other there are no predatory birds. Starlings live in both environments. In the environment with sparrow hawks, natural selection will favor the starlings that live in large groups. It may also favor dull colored starlings that are hard to see, and those that are silent most of the day. Natural selection will also favor starlings that fly quickly and escape sparrow hawks.

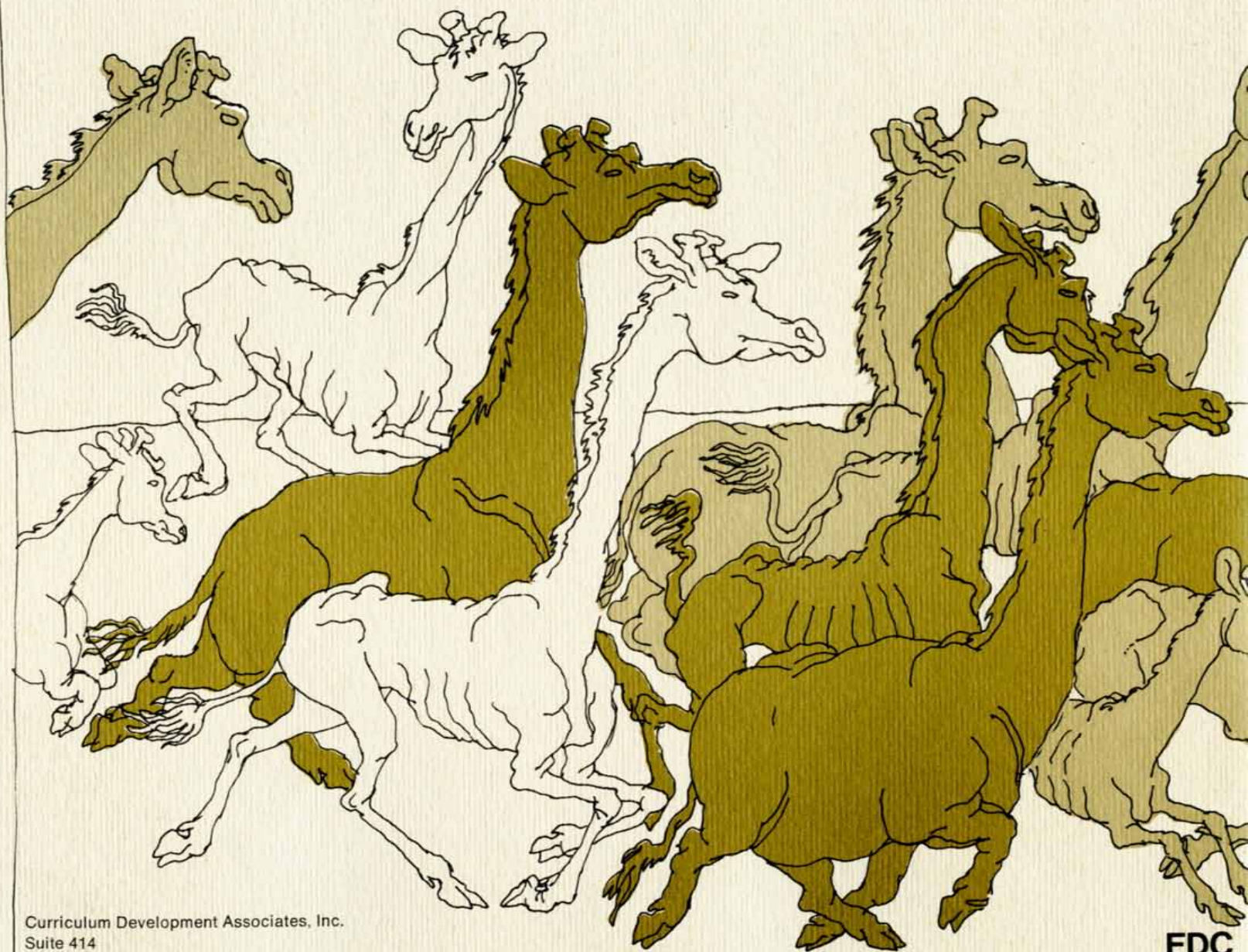


In the environment with no predatory birds, natural selection may favor starlings that live in small groups, because they may be able to find more food that way. It may favor brightly colored starlings that sing much of the day because they may be the ones that find mates and avoid fights. Finally, natural selection may favor starlings that fly slowly, because this will save them energy.



Although the two environments are almost exactly alike, the starlings will become less alike. Natural selection works to make the starlings in one environment more and more different from the starlings in the other. After many years the two groups of starlings may be so different that they can no longer mate with each other. They will then be different species.





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