COLLINS
ENCYCLOPEDIA
OF ANIMALS

COLLINS ENCYCLOPEDIA OF ANIMALS

by

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INTRODUCTION

In English usage the term animal is frequently used when mammal is what is meant, and there is no doubt that in everyday speech this is understood. Zoologically, however, the substitution is not permissible, because it is not correct. All living things which are not plants are animals: thus men, whales, elephants, snakes, tadpoles, robins, flukes, herrings and fleas are animals. But of this list only men, whales and elephants are mammals. The older way of referring to the mammals as quadrupeds is equally invalid, because there are animal species with four legs that are not mammals: for example lizards, frogs and crocodiles. What, then, is a mammal?

Mammals are warm-blooded; but so are birds, which are not mammals. Mammals give birth to living, fully developed young; but so do certain snakes and lizards, and they are not mammals. One group of mammals, the Monotremes still lays eggs, as birds, fishes and reptiles do, but the Monotremes are obviously mammals. Mammals are covered with hair or fur, although this may be scant or absent as in the marine species such as whales, dolphins and manatees. Mammals possess mammary glands which secrete milk with which the mother nourishes her young, and this is something which no other group of animals does. Mammals can therefore be described as warm-blooded animals, with fur or hair covering, that suckle their young. Although no other animal group possesses hair or fur, some mammals are almost hairless, so the mammary glands are the real diagnostic feature of the group.

Like the warm-blooded birds, mammals maintain a stable body temperature which is not influenced by the temperature of the surrounding air or water. The hair or fur (blubber in the case of many marine species), insulates the mammal against the cold; thus men living in the Arctic

have the same blood temperature as men living in the tropics. In addition, mammals have skin glands. Under very hot conditions mammals can prevent a rise in their body temperature: they can keep themselves cool by secreting fluid from the glands, by panting and by raising their fur, or hair, on end to help loss of heat. Cold-blooded animals do not have this regulating mechanism, so are much influenced by rises and falls in temperature. Once the weather is sufficiently cold, snakes, lizards and frogs, become sluggish and torpid, and have to go into hibernation.

In areas where summer and winter temperature differ greatly, the mammals respond by growing thicker coats in winter and thinner ones in summer; that is they insulate themselves more heavily when the temperature is low. In the same way human beings put on more clothes. This difference is particularly noticeable in the group known commercially as fur-bearers, whose pelts in winter are thicker and therefore much more valuable than their summer coats.

There are a few exceptions to this and, in Britain, the bats, the dormouse and the hedgehog are examples. They go into hibernation as do reptiles, and virtually give up their temperature control for the time being. Hence their blood temperature during hibernation is lower than normal, and all their bodily functions slow down — heart-beat, respiration and so on. During this reduced rate of activity they exist on a layer of fat laid on before hibernation.

Reproduction in mammals is standardised for the vast majority. The young grow inside the mother's body, deriving their nourishment from her by way of a placenta. They are then born fully developed, and are nourished further on the milk from her glands. Some young are born blind and naked; others are born clothed in fur and with their eyes open; but all have a period of helplessness of long or short duration. In the Monotremes the egg-laying habit has been retained. In the Marsupials the young are born as mere embryos, which crawl over the mother's fur into a pouch where they complete their development attached to her nipples. This is the way of the kangaroos.

Mammals have become widely differentiated and diversified by differing modes of life and feeding habits. This shows especially in their limbs and teeth. The horse's foot has become modified into a hoof because it is a running animal that once lived solely on plains. The feet of the cats are clawed; those of the otter webbed. The limbs of the seals have become flippers; the whale is superficially like a giant fish. The carni-

vores have teeth for tearing flesh, the rodents teeth for gnawing, and the herbivores teeth for grinding herbage. Teeth and limb structure are two of the features taken into account in the classification of mammals into Orders, Families and Genera. The basic unit is the species; related species become the Genera; allied Genera are included in the Family; and related Families become an Order. Thus we have the Order of Carnivores which includes cats, dogs, stoats, bears and badgers; the Order of Marsupials which includes all the kangaroos and wallabies; the Order of Primates which includes all the monkeys and man. There are nineteen Orders of Mammals, and the number of listed species alive to-day is over four thousand. In the past many species were included in groups to which they are not now considered to belong. The groupings in this work comply with the most modern classification.

Mammals to-day are under greater pressure from man than ever before. Apart from the North and South Pole, man has colonised almost every corner of the earth in his search for more and more living space for his increasing population. Any mammal that frustrates his design, by getting in his way or competing with him for food, is likely to be subjected to pressure, and may disappear altogether. Some species are on the verge of extinction. The largest species are usually the most threatened, because they take up more space by reason of their bulk. Smaller species are more likely to survive by escaping notice unless they too become serious competitors for food or living space. There are however increasing signs of an awareness of the threat, and efforts are now being made by men and governments to conserve what is left of the world's wild mammals, and wildlife generally. Protection is only a part of this; management is more important and this is the modern concept.

NOTE ON THE CLASSIFICATION OF MAMMALS

In the Animal Kingdom, the Vertebrates, (animals with a backbone and a bony skeleton), are divided into 5 CLASSES: Mammals, Birds, Reptiles, Amphibians and Fishes. The CLASS of Mammals is made up of over 4,230 SPECIES and these are split up into 19 ORDERS. Each Order is different in important ways from every other Order. An Order contains groups of Species, each group being related to every other group within the Order, but differing in some way from it. Such groups are the FAMILIES. The basic unit is the Species and closely related Species are placed in a GENUS in the Family. The plural of Genus is GENERA; thus we speak of a Family being composed of so many Genera. In this book we list only Orders and Families, avoiding other subgroupings which would be too obtrusive in the text and would overload it with Latin names. Let us see how this works out in practice.

Take the domestic horse as an example. It belongs to the Order **Perissodactyla,** which means odd-toed Ungulates (hoofed) animals. The Family to which it belongs is the *Equidae,* which includes wild asses and zebras as well as horses. The domestic horse bears the Species name of *Equus caballus*. Thus the horse, known as *Equus caballus,* belongs to the Family *Equidae* within the Order **Perissodactyla.** Now take a well-known flesh-eating animal like the fox. It belongs to the Order **Carnivora.** Within this Order it belongs to the Family *Canidae* or Dog Family, and it is known as *Vulpes vulpes*. Thus the fox *Vulpes vulpes* belongs to the Family *Canidae* within the Order **Carnivora.**

On the opposite page we show a table of the Orders, Families and Species that make up the Class Mammalia.

class
|
order
|
Family
|
Genus
|
Species.

ORDER: MONOTREMATA

Most people know that mammals give birth to living young, but it is not so well known that a few of them lay eggs. The few species which do so — the Monotremes — are found in Australia. About seven different types still exist there to-day.

It was once thought that they were a link between the birds and the mammals, but they are in fact true mammals. The laying of eggs by these few species is a heritage from the reptiles which were the common ancestors of birds and mammals. This all happened many millions of years ago.

Apart from their egg-laying, they resemble other mammals in almost every other way. They are warm-blooded and their bodies are covered with fur, except in the case of the ant-eaters whose hair has become transformed into spines like the spines of the hedgehog. They suckle their young. But while other mammals have special mammary glands supplying milk to external teats, the animals of this Order secrete it through the skin on to the hair of the abdomen, and the young lick it from there.

In two members of the group, the duck-billed platypus and the spiny ant-eater, the males have a horny spur with poison glands on the heel. It is not known how these spurs are used, but experiments have shown that poison from the glands can kill a rabbit by causing the blood to coagulate.

PLATYPUS

Family ORNITHORHYNCHIDEA

The most remarkable feature about the **Duck-billed Platypus** is its snout which is exactly like a duck's bill with nostrils at the end. The eyes are placed on the sides of the head and have the triple reptilian eyelid found in the spiny ant-eater. The body is covered with thick, brown fur with a silvery bloom. The platypus has short legs, and webbed feet with strongly clawed toes. It swims well and digs well and has a flattened beaver-like tail. A fully grown male will weigh 4 pounds and measure 22 inches in length, including $6^1/_2$ inches of tail.

The home of the duck-billed platypus is South-western Australia and Tasmania, where it frequents river banks overgrown with vegetation. But it is now a rare animal. The Australian colonisers, like all colonisers, showed scant concern for the wildlife they encountered and the platypus was killed off for no reason at all. Nowadays, it is completely protected by law and only in very special cases is permission given to catch young ones for zoological collections. Rearing a young platypus is not easy and only the biggest zoos, with highly trained personnel, can boast this achievement. But in spite of all the care that is given to them, the young animals do not live long in captivity.

The meat of the platypus, like its coat, smells of fish oil and both are therefore worthless commercially. The strong smell comes from the sebaceous glands which lubricate the fur to make it waterproof. Even the best trained hunting dogs are kept at a distance by this strong smell.

Duck-billed Platypus

The platypus is completely at home in the water and moves about in it as expertly as any otter. It dives perfectly and can remain submerged for long periods; even the entrance to its home is underwater. The burrows, which are in river banks, are several yards long. At the end of one of these burrows, the platypus makes its sleeping nest of leaves and water plants. Like the spiny ant-eater, the platypus lives a solitary life for most of the year. In the mating season, the male and female call to each other with a whistling note. The female prepares a nest of leaves for her future family and lays from one to three eggs in it. These have the same hard shells as birds' eggs. The female seals the burrow mouth and sits, or rather lies, on the eggs for about ten days or more, when the young hatch out. The young animals remain in the burrow for a very long time as their eyes do not open until they are eighteen weeks old.

The young animals feed on their mother's milk, but do not suckle in the usual mammalian way. When feeding her young, the female lies on her back and the milk is licked from the area of the mammary glands where it has accumulated in a fold of skin. At this time, the young animals have ten milk teeth in their bills, four in the upper jaw and six in the lower, but they lose these when they reach maturity and grow little, horny plates instead.

The bill of the platypus is, of course, its most remarkable feature. It is more sensitive than human fingers and its extraordinary sense of touch helps the platypus in its search for food. Its eyes are not much use to it. When hunting, it sifts the mud with its bill just like a duck and thus selects worms, shrimps, insects and slugs, tadpoles and other prey. At times it feeds on water-plants and when doing so moves its lower jaw from side to side like a cow chewing the cud. The amount of food platypuses can consume daily has been measured experimentally in New York Zoo, where two young animals devoured several hundred earthworms each day. Until earthworms were bred specially in the zoo, the entire personnel, including the director himself, had to spend their nights catching them for the young animals. From this it would seem that the platypus in the wild state has to hunt round the clock.

ECHIDNAS

Family TACHYGLOSSIDAE

The **Spiny Ant-eater**, or **Echidna**, resembles the European hedgehog, and is recognisable at a glance by the array of spines protruding from its thick fur. The

upper fur is dark brown, and the under fur light brown. The spines on the back and sides are short and strong. Like the hedgehog the spiny ant-eater can roll itself into a ball, thus presenting a defensive array of barbs, and this defensive posture is usually enough to keep any enemy off.

The spiny ant-eater measures about 18 inches in overall length. Its body is thickset; its legs short, with strong claws. The small head is elongated and tapers to a long beak-like snout. The mouth is so small that only the long tongue can pass through it. Instead of teeth this ant-eater has warts on its palate with which it grinds its food. The upper and lower jaws are so firmly joined that only the very tip of the mouth can open, and the beast could not bite even if it wanted to.

The eyes, like those of all ornithodelphians, betray the ant-eater's reptilian ancestry by the presence of the third eyelid, or nictitating membrane. The eyes are small, placed on the side of the head, and not much use for seeing with. In any case, the ant-eater does not need them as it is strictly nocturnal in habits, and hunts mainly by smell.

Although the spiny ant-eater has no outer ear, and the ear openings themselves are hidden amongst its spines, its hearing is acute and the slightest rustling noise is sufficient to make it dig itself in, or curl into a defensive ball.

Spiny ant-eaters are found in Australia, New Guinea and Tasmania. Their main habitat is sparsely wooded and rocky ground. They become active at sunset, and hunt throughout the night. During the day they hide in rock crevices.

The main prey is insects and termites, which are located by smell. When the ant-eater finds an ant-hill, it digs it up. The disturbed ants stick to its tongue and are ground up by the horny warts on the palate. The salivary glands secrete a sticky saliva so that the ants are caught like flies on a fly-paper. The thick fur protects the ant-eater from the bites of its prey. At first light, the hunter returns to its rocky crevice or to a burrow which it has dug for itself. The animal is a highly accomplished burrower and, in a matter of seconds, can dig itself in until only the top of its back is showing.

Although it is a clumsy creature, the spiny ant-eater is not easy to catch, because it frequents inaccessible places and can dig itself out of sight almost as soon as it hears the rustle of an intruder. People quite often get nasty wounds when trying to dig out an entrenched ant-eater, not because the animal bites, because it cannot, but because of its defensive spines, against which even leather gloves are no protection. During the day, the best aid a man can have in finding the sleeping quarters of an ant-eater is a well-trained dog, which can smell the animal out.

The ablest hunters of the spiny ant-eater, and probably its main predators, are the Australian aborigines. Their keen eyes quickly detect any trace of its whereabouts, and yet, despite this, they rarely succeed in catching more than four or five in a day. The aborigines consider the ant-eater an excellent titbit and cook it in the

Spiny Ant-eater

same way as many European gypsies cook the hedgehog — by wrapping it in mud and roasting it — fur, spikes and all. When properly baked, it is much more easily skinned. The flesh of the spiny ant-eater does not appeal to the European palate.

In recent years, zoologists have discovered two important facts concerning the spiny ant-eater. Firstly, its body temperature is not stable. We know that the majority of mammals, including man, have a constant body temperature, as do birds. The average temperature of the human body is 36° C. (98.4° F.). When this temperature rises to 40° C. the person is in a state of high fever. In reptilians, on the other hand, the temperature varies according to the surroundings, thus they must hibernate during the coldest weather and are able to move about only during the months when their bodies can get sufficient warmth. The spiny ant-eater, as well as other ornithodelphians, goes torpid as soon as its body temperature rises or falls below certain levels. This torpor is a similar condition to the winter hibernation of our winter sleepers: the hedgehog, marmot, etc.

The second point concerns the breeding season of the spiny ant-eater, which is in July and August. During the breeding season, the female ant-eater develops a pouch on her abdomen, which is supported by fork-like bones growing from her pelvis. In this pouch, the ant-eater lays an egg about the size of a hazel-nut. The egg has a shell, just like the egg of a bird. When she is ready to lay, the ant-eater lies on her back and curls up into a ball so that the egg will fall straight into the pouch. The egg is kept warm by the animal's body. The young ant-eater grows upon its nose a little egg tooth with which it cuts its way out of the shell, just like a bird. The egg tooth falls off soon afterwards and its place is taken by a milk tooth. With this, the young animal rubs an area on the mother's abdomen from which a thick, yellow milk soon oozes on to the surrounding hair.

The newly born spiny ant-eater, hatching from an egg no bigger than a hazel-nut, is a very tiny animal, but it grows quickly and in a matter of six weeks or so reaches a length of over 3 inches. But it does not reach maturity until the second year of its life.

ORDER: MARSUPIALIA

There are about two hundred species of marsupials in the world, most of them in Australia. The group includes carnivorous and herbivorous types and there is great variation in their appearance. Some species resemble squirrels and live in the tree tops. Others hop about on the ground, and still others burrow underground like moles. Some species are able to parachute down from tree tops by spreading out a fold of skin. In fact, many marsupials imitate certain characteristics of other groups of mammals; so much so that, for a time, some zoologists believed the marsupialia were the common ancestors of all other mammals. This is not so. What happens is that similar living conditions lead to certain superficial similarities in different animal groups.

The only other types of mammals found in Australia were bats and mice. Only later, with the advent of the settlers, were such species as the wild dog, or dingo, introduced. Before the days of the colonists, the marsupials had no natural enemies other than man. Now they had to face completely new conditions for which they were not adapted, and they began to dwindle in numbers under pressure from man, dogs and cats. To-day so few of them remain that they have to be protected by strict laws or they would die out completely.

The brains of the marsupials and the brains of the monotremes are not highly developed, and of little consequence. Even the young cannot be tamed. They never become attached to man and cannot even recognise the attendant who takes care of them.

In the marsupials the unborn young is not joined to the mother's body by a placenta during development. In the higher orders of mammals, the placenta is the structure through which the growing young is nourished. Otherwise, marsupials have all the usual mammalian characteristics — warm blood, covering of hair, sebaceous glands, mammary glands and nipples. The kangaroo has two nipples. Certain other marsupials have up to twenty-seven. The nipples are usually hidden by the fold in the skin, which forms a kind of pouch.

As in the case of the platypus this pouch, or pocket, is supported by special bones growing from the pelvis, and along its edge there is a muscle which contracts and closes the pouch to prevent the young from falling out when the mother is moving about. When the young animal is a bit older the pouch opens up so that it can jump out while the mother is at pasture. The pouch also opens when the mother is about to take flight. The young animal jumps into it and the pouch closes again.

The young at birth are extremely small. The kangaroo, which will stand 7 feet tall as an adult, measures only one inch when born. The female lies on her back when she is giving birth to it and licks a track through her fur which the tiny youngster follows unerringly to the pouch. There it clings firmly to the nipple, so firmly indeed that Australian farmers used to think that it grew from there. If forcibly removed, its mouth is torn and it bleeds to death.

OPOSSUMS

Family DIDELPHIDAE

Opossums are the typical representatives of this order, the members of which vary greatly in size. Some are no larger than mice; others grow as big as a cat. Remarkably, this family is found in South America and even in parts of North America.

Opossums are night hunters. They spend the day curled up into a ball, asleep. Although originally forest animals, they soon become accustomed to man and now even invade his dwellings. Besides shelter, they often find food there, including rats and mice which are a favourite prey.

Most opossums are expert tree climbers and no obstacle is too high or too difficult to be surmounted. On the ground, they are generally clumsy and slow. Like the bears, they tread on the whole sole of the foot when walking.

The **Virginia Opossum** is found mostly in the southern states of North America and is the best known of the numerous species. Its general appearance is that of a big rat and its tail is hairless and scaly like that of the brown rat. Its overall length ranges up to 3 feet, about four-fifths of which is tail.

The hunting opossum, whether it is climbing trees or hopping over the ground, is a cautious animal which examines and sniffs everything in its path with its pointed pink snout, and all American zoologists agree that this instinctive precaution often saves its life. The most attractive titbits do not always succeed in bringing the opossum to a trap. It has, in fact, the reputation of being very trap-wary. Nevertheless, statistics show that half a million are caught every year.

Virginia Opossum

Man hunts this seemingly innocent animal for the most varied reasons and routine killing is often carried out for no reason at all. It is not liked on or near chicken farms, where, fox-like, it will run riot in a hen-house and kill every bird it can reach. A visit like this, however, usually ends in tragedy for the opossum, because once he has eaten his fill he falls asleep on the spot, and there the farmer finds him in the morning, curled into a ball in the middle of a heap of dead chickens. A shot, or, more likely, a blow from a stick brings the opossum's life to a sudden end.

A dead opossum is often only apparently dead. It is, in fact, so good at shamming dead, that it can easily deceive even an experienced person and from this comes the well-known phrase "playing possum". At the slightest blow it closes its eyes. With mouth open and tongue hanging out, it lies limp, apparently dead, but as soon as the killer moves away the "dead" opossum leaps up and makes off. Some beetles also behave in this way, but among mammals, only the opossum habitually

does so. The behaviour is, of course, purely instinctive and is not in any way a reasoned act.

Man tends to pronounce judgment on the opossum, solely in its rôle of predator. He does the same with other animals, considering the harm they do and ignoring the good. But no predator is a pest all the time and this is as true of the opossum as it is of any other animal. The occasional damage done by opossums when they raid a farmyard is more than compensated for when the beasts are destroying harmful rodents. The opossum is the greatest enemy of the cotton rat. By destroying these creatures it not only saves man's property, it protects human health as well, because these small rodents spread infectious diseases among people and animals. The opossum is not wholly carnivorous; it feeds also on fruits and other parts of plants.

The opossum is hunted for its fine soft fur and each year the number of pelts used as fur linings and other additions to women's clothing runs into hundreds of thousands. Some people hunt the opossum for its meat, which has a strong smell of garlic, and its flesh is a titbit coveted by Negroes and Indians.

Brehm has described how Negroes, helped by a dog, catch opossums. The opossum hunt is carried out in full moonlight and the hunted animal tries to escape by climbing up a tree. It is either shot down or taken alive. If taken alive, it is put in a cage and fed on fruit to fatten it in much the same as the Romans used to do with the edible dormouse.

In almost all books on natural history, old or new, the opossum is described as being very stupid and obtuse. Nevertheless, we know that every species is adapted to the life it leads in its own environment and the opossum is well equipped to survive

Virginia Opossum feigning death, i. e. "playing possum"

in its own niche. If we put one in a lighted room it becomes extremely frightened and agitated, because it is a nocturnal animal upset by conditions it is not equipped to face. If an opossum is placed directly in the sun, its fur gets so hot that the animal begins to scorch. If it is exposed to the sun for half an hour, even in a temperate region, it will die.

The opossum's most highly developed sense is its hearing. This is so acute that it can detect the slightest movement of an insect in the grass. Its large ears, which

Virginia Opossum with young

New World Opossum

are constantly twitching, can pick up the slightest whispering noise. You might think that this ultra-acute hearing would be a disadvantage when the animal was trying to sleep, but nature has supplied an answer to this. Just before sunrise, when the opossum is settling down to sleep, it rolls up its ears into two little tubes, which are then folded over so that no sound can penetrate.

The animal's sense of smell is not very marked and it has practically to fall over food before it finds it. It is for this reason

Water Opossum

that it sniffs everything at close range. Its eyesight is poor, but of course being nocturnal it has no great need of sharp eyesight.

The opossum is an expert climber and makes great use of its tail, which serves as a fifth limb. It can even hang head down by its tail. When it cannot reach fruit or a bird's nest from below, it will climb to a higher branch and reach down, hanging by its tail. The tip of its tail is as sensitive as a human finger. The opossum has other uses for its tail, notably for carrying branches when it is building its nest. Firstly, it makes a bundle of the little branches it has torn off, then it winds its tail round the bundle and twists it into a kind of knot. The female will often carry the half-grown young on her back with their tails hooked round her own.

Reproduction in the opossum is the same as in other marsupials. The gestation in the female is very short — under thirteen days. She has from eight to sixteen young at a time. They are less than half an inch long and like the young of the kangaroo very imperfectly developed. They complete their development in the mother's abdominal pouch.

Apart from the Virginian opossum, South America has several other species which resemble it in size and way of life. The smallest opossums are the **South American Pouched Shrews**. They are about the size of our own water shrew, which they resemble in general appearance. They differ from other opossums in being terrestrial. They live close to streams and rivers, and further resemble the shrews in their active way of life.

The **Water Opossum** is a South Amer-

ican species which inhabits rivers and streams. It is rat-like, with thick fur, grey above and white below, and has six black stripes across its back. The hind feet are five-toed and webbed. It is an expert diver, perfectly adapted for its aquatic life, but it is also nimble and active ashore. The overall body length is about 16 inches.

This species preys upon fish and small water animals and can store small prey in its capacious cheek pouches.

Because it is shy and retiring as well as rare, not much is known about its general habits. Like all marsupials, the female water opossum carries her young in a pouch, and it seems that they remain there even when she is swimming and diving.

DASYURES
TASMANIAN DEVIL, TASMANIAN WOLF, ETC.
Family DASYURIDAE

The Dasyuridae are carnivorous marsupials found in Australia. They differ mainly from the opossums in having a furred tail which is never prehensile. Most of them have teeth resembling those of the carnivores.

The **Native** or **Dasyure Cat**, is one of the handsomest members of the family. It is about 16 inches in overall length and closely resembles a marten. Its yellow-brown pelt is thick, smooth, and spotted with white. The long, shaggy, pointed tail has a white tip. The eyes are black and lustrous.

Like most carnivorous marsupials, the native cat is nocturnal, spending the daylight in sleep. For this reason it is not popular in zoos.

Australian farmers have always waged war against the native cat because of its predation on small livestock such as poultry. Like the marten, or the fox, a raiding native cat can do a lot of damage in a farm on a single night. As a result, it was persecuted by farmers to the point of extinction and was saved only by the intervention of conservationists.

But no so-called pest animal is a pest all the time. There is always another side to the story, and native cats in fact prey heavily on destructive rodents. In addition, they are scavengers, notably on the beaches where they pick up dead fish, crabs and other marine animals washed up by the tide. They also feed on insects. The native cat's predation on livestock may therefore be more than compensated for by its good work in other directions.

Litter size is usually from four to six. Young mature slowly and remain for a long time in the mother's pouch.

Native Cat

Tasmanian Devil

The **Tasmanian Devil** is black-haired and stocky, with a short rat-like tail and lips covered with warts. It is about the size of a badger. The hairs on its head and breast are so sparse that the reddish skin shows through.

When a Tasmanian devil becomes angry or excited, the blood rushes to its skin so that the head and hairless ears turn quite red. The emotive name *Devil* arose from its unprepossessing appearance.

It is generally agreed that the Tasmanian devil is absolutely wild and untamable. The same has been said about the Scottish Wildcat, but this belief is based on experience with captured adults, and it is quite likely that the young of either, taken before their eyes opened, would grow up tame.

The Tasmanian devil is a powerful animal, strong-bodied and strong-jawed and has been incessantly persecuted in its native Tasmania because of the destruction it can cause among small livestock on its occasional raids on farms. The naturalist, Krefft, has reported what happened when a Tasmanian devil escaped from captivity. In two nights it had killed 54 hens, 6 geese, an albatross and a cat. Then it got caught in a steel trap, the jaws of which were made of wire the thickness of a pencil. It escaped by bending the wire. Yet the blacksmith who repaired the trap had to use special tools to straighten it again. A similar case has been described by the former director of the Vienna Zoo. In this case, the animal escaped by bending and biting through the strong bars of its cage. Modern experience has shown that if a Tasmanian devil is kept in a darkened cage, suitable to its nocturnal habits, it settles down quietly and makes no attempt to escape.

In the wild, the Tasmanian devil feeds on mammals and birds, but it will also take carrion, including dead fish. It bites easily through thick bones. Because of its nocturnal habits, little is known of its breeding biology. It is known that the female has from three to five young at birth, but so far it is not known for how long she takes care of them.

The first colonisers to Tasmania hunted the Tasmanian devil because of its predation on farm stock, but they also ate it and its meat was said to taste like veal. To-day this rare animal is found only in remote and uninhabited parts of Tasmania.

Tasmanian Wolf

The **Tasmanian Wolf** is the largest of the carnivorous marsupials, measuring 5 feet in overall length, of which 20 inches is tail. It closely resembles the dog in general appearance, its head being strik-

ingly dog-like. Its body is covered with short, grey-brown fur and it has from twelve to fourteen transverse black bands on its back. It is found in Tasmania.

Although the Tasmanian wolf resembles the dog, it lacks the dog's intelligence and ability. Even when caught very young and brought up in captivity it behaves with complete indifference towards its keeper, and none so far has been tamed. The Tasmanian wolf does not bark; it utters a snort, similar to that of a kangaroo.

Owing to its size, the Tasmanian wolf is the most powerful of the carnivorous marsupials. It attacks all Australian birds and mammals, but is not dangerous to man. It hunts the kangaroo and will even attack the spiny ant-eater, whose spines and remains have been found in its stomach. With the coming of the colonisers, the Tasmanian wolf was able to add sheep and poultry to its prey list. Because of this, farmers offered a reward for the destruction of every Tasmanian wolf, or "Native Tiger", with the result that the species was brought to the verge of extinction. Now it is protected by law, but there is some doubt as to whether it still exists. Hillary, the conqueror of Everest, organised an expedition to Tasmania, but did not see a single Tasmanian wolf.

Banded Ant-eater

The **Banded Ant-eater** is perhaps the most attractive of all the marsupials and resembles a kangaroo. Its body is 10 inches long and the tail 7 inches. The head is pointed and the tail covered with thick, black fur. The fur is ochreous in front, darkening into black at the back, and the dark buttocks are striped with white and red. The banded ant-eater probes into ant-hills with its tongue and when this becomes covered with ants it is withdrawn quickly into the mouth. Unlike its relatives, the banded ant-eater is perfectly harmless when caught and does not make any attempt to bite a man's hand.

MARSUPIAL MOLE
Family NOTORYCTIDAE

The **North-western Marsupial Mole** closely resembles the Common Mole in its shape and way of life. Because of its secretive, underground life, the species remained undiscovered until the end of the nineteenth century. This marsupial has silky, golden fur. The top of its snout is covered by a horny shield and its feet are armed with strong claws. There is a button-like horny shield at the end of the tail similar to that on the snout. It is a highly efficient burrower and can disappear in a matter of seconds, even when put down on hard ground. Because it spends the greater part of its life underground, it has no need of eyesight and is,

North-western Marsupial Mole

in fact, completely blind. The eyes are covered with muscle and skin. It has small ear openings under the fur, but no external ears. The pouch of the marsupial mole opens backwards, which ensures that no earth can get into it when the female is burrowing. The marsupial mole lives on the larvae of various insects and on ants and earthworms.

BANDICOOTS
Family PERAMELIDAE

Long-nosed Bandicoot

The **Bandicoot** family is made up of twenty species. They are all about the size of the brown rat, but have somewhat longer hind legs and a long snout. The second and third toes of their hind feet are small and fused up to the nails; the fourth and fifth toes are large and free. Bandicoots inhabit the higher regions of Australia, Tasmania and New Guinea, living in burrows which they dig out for themselves. They feed on insects and plants.

KANGAROOS AND WALLABIES
Family MACROPODIDAE

The kangaroos are without doubt the best known of all marsupials, and every small child has seen pictures of a kangaroo mother with her young peeping out of her pouch. All the members of this great family are herbivores and none shows any carnivorous tendencies.

Typical of all kangaroos is the body shape. The chest is narrow and the front legs short. The hind-quarters are muscular and strong, the hind legs long and powerful. The disproportion between fore and hind-quarters is striking. The body is carried by the strong hind legs which are used for tremendous forward bounds. Then there is the thick muscular tail; it serves as a support for the body and, together with the two hind legs, forms a sort of tripod. The tail does not touch the ground when the animal is running. It is, therefore, untrue to say that kangaroos use their tail for upward or forward thrust, although this is often stated. Its function is that of a rudder.

Kangaroos do not run; they move forward in great leaps. In slow movement they will cover from 3 to 6 feet in a single leap, but when in headlong flight from an enemy,

they will make leaps of over 30 feet, so that even a fast horse can hardly catch up with them. The kangaroo can easily take in its stride thick bushes which a horse or dog must run round. Because of its tremendous stamina, the kangaroo can wear out a horse long before it begins to tire itself.

The feet of the kangaroo have their own peculiar adaptations. The animal actually treads on only one toe, the fourth, which has a strong claw. The fifth toe is shorter and much less developed. The third is missing completely, while the second toe is fused with the third forming a single small toe with two claws. The kangaroo uses these small claws to clean itself and comb its soft fur. Good runners often have such stunted toes. Just think of the horse which uses only one, the third, the others having become vestigial during the animal's evolution. Another good example, this time among birds, is the ostrich, which has preserved only two claws out of the original four.

The kangaroo's short forelegs are not used for running; only when grazing will it occasionally lean on one. The forefeet have five normally developed toes with claws, which can be used for holding food or for scratching places where the hind feet cannot reach.

All kangaroos live in herds on the Australian steppes. Each herd is led by an old male; every member of the herd obeys the leader and in flight follows him without question. The first Australian settlers saw herds numbering up to one hundred, but smaller units are now the rule as the species has been much reduced by man.

The kangaroo herds graze on grass and bushes. Most activity takes place at dusk or during the night, especially in areas where hunting pressure is severe. In uninhabited areas, the animals will graze in the daytime. After grazing they lie down to rest, usually on their sides, but some of the smaller species squat down like hares, especially the young animals. The young play a great deal. One form of play resembles a boxing match. Two males stand on tiptoe facing each other, using their tails as support. At the beginning they merely embrace each other with their forepaws, but as they warm up they strike violent blows at each other's head. No serious damage results although a boxing match may last for some hours.

During the rut, when the males are fighting for females, this boxing can have more

Comparative sizes of Kangaroos (from left to right): Great Grey Kangaroo, Red-necked Wallaby, Brush-tailed Rock Wallaby, Grizzled Grey Tree Kangaroo, Rufous Rat Kangaroo, Musky Rat Kangaroo

Red Kangaroo

serious results. Then the animals also use their hind legs and can inflict serious wounds with their long, sharp claws.

In kangaroos the senses of smell and hearing are acute, and at the slightest suspicious sound several members of a resting herd will immediately stand tall, seeking the cause. Immediately an animal sees or smells danger, it warns the others by striking the ground with its hind feet. As a result, it is not easy to approach a herd of kangaroos, and hunters have often to drive them on to ambushed guns, using specially trained dogs. Only an expert marksman can shoot down a running kangaroo. When a herd is being hunted and is hard-pressed, the older males will cover the retreat of the females and young. Standing with their backs against a tree or rock so that they cannot be attacked from behind, they attempt to hold off the dogs with strong blows from their hind legs. Such a blow could disembowel a dog and inexperienced ones are often killed. But in spite of such resistance, the kangaroo is usually overwhelmed by other dogs of the pack, or shot by the hunters following on horseback.

Man is the most ruthless predator on kangaroos, especially on the smaller species which are killed for their fine fur. Unlike the fur hunters, the aborigines kill kangaroos only for meat. Among the kangaroo's natural enemies are the Australian wild dog — the dingo, the Tasmanian wolf and, nowadays, domestic dogs that have been allowed to run wild. To-day, however, the hunting of kangaroos has been curtailed and many herds exist peacefully on reservations.

In captivity, kangaroos live very quietly, feeding on grass, carrots, potatoes, oats and the like. Being timid they take flight readily and often injure themselves crashing into wire fences. They have been introduced into Europe and do not seem to mind the European winter, some of them even giving birth to young during the winter months.

From among the numerous kangaroo species, we have chosen a few of the best known.

The **Grey** or **Giant Kangaroo** is the biggest of all. When sitting on its hind legs it is as tall as a man and when standing erect it is even taller. Its overall length is

nearly 10 feet, of which nearly 3 feet is tail. A mature male will scale over 220 pounds, but males up to 350 pounds have been caught. Females are about two-thirds the size of the male. The fur in this species is soft, thick and grey.

To-day there are not many of these kangaroos left. Their main enemy was the sheep farmer who hunted them ruthlessly because they grazed on pastures reserved for sheep. This species is hunted mainly with hounds in organised beats, and when hard-pressed can be dangerous even to man. During such hunts it was discovered that the giant kangaroo can swim well. Under such pressure females will throw their half-grown young out of the pouch to reduce weight during flight.

The **Red Kangaroo** is as big as the previous species. It is often kept in zoos because of its attractive reddish-brown colour. Particularly attractive is the red colour of the neck and breast from which the species derives its name. The red is not the actual colour of the hair, but is a pigment secreted by special glands. If a white handkerchief is pressed over the breast of this kangaroo a red substance similar to pollen will stick to it.

The **Red-necked** or **Bennett's Wallaby** is a medium sized species, a little over 3 feet tall at most. It has fine grey-brown fur with a tinge of red.

The **Brush-tailed Rat Kangaroo** belongs to the group of so-called rat kangaroos and is about the size of a rabbit with a brush of black hair at the end of its long tail. It was once common but became extinct over wide areas after the introduction of the European fox. It hides by day and emerges by night to feed on grass and

Red-necked Wallaby

Brush-tailed Rat Kangaroo

Musky Rat Kangaroo

Brush-tailed Rock Wallaby

Grizzled Grey Tree Kangaroo

roots. The Australian settlers nicknamed it the sweeper because it visited their camp fires to clear up food refuse. It still frequents the neighbourhood of villages in search of food.

All rat kangaroos have prehensile tails which they use for carrying away nesting material.

The **Musky Rat Kangaroo** is one of the smallest species, and differs from the others in shape as well as body size. It is about the size of the brown rat, which it closely resembles. It has five toes on its hind feet and its tail is bare and scaly like that of a rat. Its name derives from the musk secretion of musk-glands.

The **Brush-tailed Rock Wallaby** is found in Southern Australia. It is of medium size and stands about 4 feet tall. The fur is thick and grey with a dark purple tinge which turns to black on the back. The under parts are white and yellow. It is readily distinguished from other kangaroos by the long hairy tail with a tassel tip. The tail is not as robust as that of the other kangaroos and is used mainly as a rudder during flight.

The Rock Wallaby, as its name implies, inhabits rocky mountain regions. It is an excellent climber and can scale steep cliffs and precipices with ease. In flight it can leap nine feet high during forward bounds of over twenty-five feet. During snowy or stormy weather it shelters in rocky cliffs and caves. Otherwise it behaves in much the same way as other kangaroos.

The **Grizzled Grey Tree Kangaroo** is dark brown, with white chin, throat and breast and a long, shaggy, black-and-white tail.

This is a tree-dwelling species with

stronger and more powerful forelegs than other kangaroos. The forefeet have strong, hooked claws used in climbing, and the broad hind feet give the animal good balance on the branches. The tail, which is not so muscular as that of the ordinary kangaroos, is thickly covered with long hairs and used mainly as a balancing pole during climbing.

The Tree Kangaroo feeds mainly on leaves, buds and young shoots, which it gathers with its forefeet.

WOMBATS
Family VOMBATIDAE

The **Common Wombat** is a short-legged, bear-like marsupial, about 3 feet long, with a big head and dense, flat, blackish-grey fur. It inhabits the mountain forests and rocky hillsides of Australia and Tasmania, sleeping by day curled up in its burrow, and coming out at dusk to feed. Its food consists of grasses, roots and the bark of trees and shrubs. The wombat's eyesight is poor, but its senses of hearing and smell are well developed. It locates a great variety of bulbs and roots with its nose and then digs them up with its powerful claws.

Like the European rabbit (nowadays a competitor for the grazing), the wombat excavates great burrow systems and some of its tunnels are up to 100 feet long. Afield it moves slowly and hesitatingly and tires quickly if forced to run. Because of this it does not venture further from its burrow than it has to. Burrow systems are located near water in which the wombat likes to bathe.

In zoological gardens, the wombat can be a problem; it can break its way out of a strong cage. Fortunately, it does not go far and usually digs a burrow close at hand. With its strong claws, it can dig up even tiled or asphalt flooring. On the other hand, it is a very docile animal and will not attack man, even when roughly handled.

Common Wombat

PHALANGERS, CUSCUSES AND KOALA
Family PHALANGERIDAE

Probably the most widely known of all the marsupials is the Koala Bear whose picture can be seen all over Australia on cars, advertisements, stamps, etc. It almost succeeded in being included on Australia's coat of arms. It is the original living Teddy-bear, and toy replicas are great favourites with Australian children.

Koala Bear

The **Koala Bear** is about two feet long and really looks more like a Teddy-bear than a living animal. Particularly striking is its large head with small eyes and big ears. The hair of the ears sticks up like a brush. The nose and part of the mouth are hairless and their dark colour contrasts sharply with the grey face. As a result, the koala appears to have a big brown button sewn on the end of its nose.

The koala's body is covered with thick, curly, ash-grey fur. The limbs are specially adapted for climbing. All the toes, except the thumb, have long, sharp claws, and the koala can oppose the two middle toes of its forefeet against the others. The koala spends almost its entire life in the trees, moving slowly up and along branches, biting off the young shoots and leaves which constitute its food. Only when it has to move from one tree to another will it come down to earth.

In the matter of food the koala is highly specialised, and is one of the few animals that lives on a single type of food — in this case the leaves of the eucalyptus. Because of its special requirements, most attempts to keep the koala in zoos have failed. The exception is London where eucalyptus trees were planted before the koalas were installed. Where there are eucalyptus trees, the koala needs no cage because it will spend all its time in the branches and make no attempt to escape.

During the day the koala sleeps in the top of a eucalyptus tree; at dusk it comes out to feed. All its movements are slow and its entire way of life is reminiscent of the South American Sloth.

Although the koala is absolutely harmless, it was killed off in large numbers for its fur and was in great danger of being exterminated. Nowadays, it is protected by law so there is every reason to believe that it will once again become numerous, but this is likely to be a slow process because of the koala's slow rate of breeding — one young at birth.

The pouch of the koala bear opens backwards, that is in the opposite direction from that of most other marsupials. For a long time, zoologists were puzzled as to why the koala's pouch should have developed the "wrong" way round. A few years ago, an Australian zoologist offered an explanation.

The female koala bear gives birth to only one young. Long before it is able to leave her pouch and feed on its own, its mother's milk becomes insufficient for its needs. The koala solves this problem of nutrition in a most interesting way. During certain hours, the food eaten by the mother is not wholly digested. Instead, the eucalyptus leaves are broken down into a kind of pap which passes through her digestive tract to the anal opening. The backward opening pouch enables the young animal

to stick its head out and eat the pap from the mother's anal opening. The young animal feeds in this way only once a day and always in the morning. This special manner of feeding lasts until the young is about six months old, when it becomes too big for the pouch. The mother then carries it on her back for a further six months. From this position it is able to gather leaves for itself.

The Phalangers are also tree animals and their five-toed feet are admirably adapted for climbing. There are about thirty species, the largest of which are the cuscuses, or Australian opossums. These are cat-sized marsupials, with long bushy tails. One of the most beautiful species is the Spotted cuscus which is greyish, or yellowish-white on its upper parts, spotted with rust-red or black, and white underneath. During the day, the cuscuses sleep on some sheltering branch; at dusk they come out to feed. Their food consists of fruit, leaves and buds.

On the ground, the cuscus moves very slowly, but in the trees it is agile, active and acrobatic. Most cuscuses can oppose two fingers to the remaining three so that their feet are well adapted for grasping. Chameleons have similar feet. In addition, the cuscus helps itself along with its tail, which is pliable and prehensile and can be wound round a branch.

The **Honey Phalanger,** or **Honey Possum,** is a small animal measuring about 10 inches, from the tip of its nose to the tip of its tail. It has rough, short fur, grey above, with three lengthwise black or brown bands down its spine. The honey opossum differs from other cuscuses in the shape of its head, which is elongated and pointed. It has a long, worm-like tongue designed for gathering nectar. The honey opossum climbs up to the end of a twig and gathers nectar by probing its long tongue into the flowers like an insect. While gathering nectar, it also catches insects with its sticky tongue. It differs from other members of the group in having no appendix, which is an indication of its special feeding habits; it is the herbivores that have a large appendix.

All the phalangers are absolutely harmless animals. Some species dig burrows in which they hibernate. In appearance, they resemble dormice. The female phalangers have from two to four young, which are carried in a small low-placed pouch.

Most remarkable among the phalangers are the species which are able to glide from tree to tree like flying lemurs. These are the **Opossum Gliders** and the **Squirrel Gliders**. The front and hind-legs are joined by a membrane which, unlike the membranes of bats, is covered with fur.

Honey Phalanger

Pygmy Flying Phalanger

But there is no true flight as in the bats. These phalangers merely climb to the top of a tree and parachute to a lower branch, or another tree, with membranes fully stretched. For this reason, we call such flights parachute flights. When hard-pressed, the phalangers can glide quickly over distances of 20 to 50 yards. They control the direction of their flight by using their bushy tails as rudders. When the phalangers are merely climbing the trees, the flying membranes are folded alongside their bodies.

Short-headed Flying Phalanger

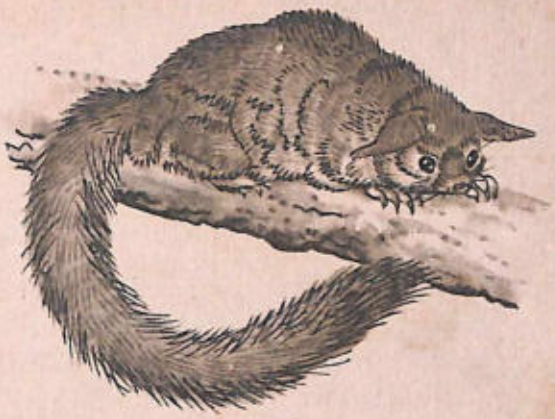
The opossum gliders and squirrel gliders have thick, fine, woolly fur. Like the cuscuses they are nocturnal animals with large, prominent, black eyes. They feed on leaves, fruits and the shoots of trees and bushes.

The **Pygmy Flying Phalanger** is the smallest of the flying marsupials, measuring no more than 5 inches in length, including tail. It lives in the forest-covered regions of Australia and feeds on insects and the nectar of a great variety of flowers.

The **Short-headed Flying Phalanger**, or **Sugar Glider**, is a much bigger animal, measuring up to 20 inches in overall length. It is widely distributed in Australia and is particularly common in coastal jungles from Southern Victoria to Southern Queensland. The sugar glider is very fond of the sweet sap of certain trees and where there is sap oozing from a tree it will remain hanging head downward on the trunk, feeding for periods up to one hour. This species can glide for distances up to 50 yards.

The fine fur of the sugar glider protects it from cold and damp. During the day it shelters in the hollow of a eucalyptus tree, curled up into a ball in its nest of eucalyptus leaves. The female usually has two young, which grow quickly and in four months resemble their parents.

The **Great Glider** is the largest member of this flying group, measuring 3 feet or more in overall length. Its habitat is the great eucalyptus forests of Southern Australia. It is strictly nocturnal and spends the night feeding in the tree tops. For this reason, it usually escapes notice and few people ever see it. According to the naturalist, Bourliere, it feeds entirely on eucalyptus leaves.



Great Glider

As we have seen, the monotremes and the marsupials are primitive mammal types which either lay eggs or give birth to imperfectly developed young. All other mammals are higher mammals, much more advanced types, and differ from the others in having a placenta. The placenta forms the link between the embryo and the mother's body during development. Through the placenta the embryo receives everything it needs from the mother for growth and the maintenance of life. At birth the young of these higher mammals are well developed.

From the tiniest shrew to the biggest living species such as whales and elephants, all are placental mammals. In this group there is great diversity in shape, size, way of life and intelligence. There is also great diversity of habitat and each species is well adapted to its particular environment.

ORDER: INSECTIVORA

The Insectivores are the most primitive types of placental mammals; they are represented mainly by the shrews, hedgehogs and moles. In these three groups we can see how body structure and outward appearance can vary, even amongst animals that are closely related. Insectivores are adapted to life on the ground, in the water and underground.

If we examine the teeth of a mole or a shrew under a magnifying glass, we shall see that they closely resemble the teeth of a carnivore; they are pointed and extremely sharp. The teeth differ only slightly from species to species.

Insectivores subsist on animal food, mainly invertebrates such as insects, worms, spiders, centipedes and molluscs; but they will also eat larger species, often in the form of carrion, but sometimes by predation. They are all voracious feeders and most of them perish quickly if deprived of food for more than a few hours. The Common Shrew, for example, could not last out even a summer night without food; whereas, the hedgehog could miss twenty-four hours with no ill effects. A small quantity of vegetable food is also eaten and is necessary for health. Some insectivores hibernate, but most are active throughout the winter.

Almost all the insectivores have five toes and walk on the flat of their feet. Species which live underground have their forefeet adapted to this type of life. The eyes are usually very small and the ears short. Insectivores live almost everywhere except South America and Australia (the European hedgehog has been introduced into New Zealand). The greatest number of species and the biggest populations inhabit the warmer regions. Only a few species are found beyond the polar circle.

TENRECS

Family TENRECIDAE

The Tenrecs are hedgehog-like insectivores. They have a long snout and small eyes. In some species, the tail is a stub, while in others, it is long and hairless. The fur of certain parts of the body has become modified to form bristles and spines.

The **Tailless Tenrec** is about the size of a cat, with a stub of a tail. The body is covered with hairs, bristles and spines and there is a dark band down the middle of the back. Only the legs and abdomen are free of bristles; the legs are short and the snout long.

Originally, the tenrec was found only in Madagascar. Now it is found on the islands of Mauritius, Mayotte and Reunion, where it probably arrived as a passenger on cargo ships in the same way as the rat reached Europe. It has become acclimatised in these places and is increasing in numbers.

The tenrec inhabits mountain regions in close proximity to water, wherever there is plenty of bush and fern cover. In such cover, it hunts and spends its life. It digs tunnels about five feet deep in which it spends most of the daylight hours asleep. At dusk it comes out to hunt insects, molluscs and worms in the mud and leaf litter. At times it hunts bigger prey such as lizards, and it sometimes eats fruit.

It is most active during the rainy season and in the tropical spring, when it begins to lay on fat for the period of hibernation. Throughout the dry season, from April to November, it hibernates, and during this period all its bodily functions slow down. If it is awakened from hibernation and placed outside its burrow it remains drowsy and is hardly able to stand.

The breeding season is in the spring. The young are born in the burrow and number from twelve to sixteen, sometimes even twenty. This high rate of breeding enables the tenrec to stand up to high predation. Man is a considerable predator and considers the meat of the tenrec a delicacy. In the local markets, carcasses are displayed and sold.

The tenrec's only defence is the musk smell produced by its scent glands, but this is not nearly so powerful as that of the skunk.

The **Streaked Tenrec** is about the size of the common mole and has a reddish coat with yellow bands.

Tailless Tenrec

Streaked Tenrec

SOLENODONS
Family SOLENODONTIDAE

Solenodons are stocky animals with a short neck and a long trunk-like snout. Their eyes are small. The scaly, almost hairless, tail is as long as the body; the overall length being about 2 feet. The forelegs are strong and fitted with curved claws; the hind-legs are shorter and thinner. The solenodons have forty teeth. Unlike other insectivores they have only one pair of nipples. There are two species inhabiting some of the islands of the Greater Antilles.

Solenodons are now very rare and may be extinct over much of their range. Not much is known about them and the most certain place to see one to-day is in a museum. Most of the solenodons were exterminated by civet cats introduced into the Antilles, and this is a typical example of what can happen when an exotic species is introduced to a country.

Haitian Solenodon

The **Haitian Solenodon** was found on the island of Haiti and the **Cuban Solenodon** on the island of Cuba, where it was called Aemigui by the natives. Both species may well be extinct.

The solenodons inhabited mountain forests, living in burrows which they excavated with their strong claws, and the ruins of these burrow systems can still be seen to-day where the animal no longer exists. The solenodons hunted their food in the mud and forest litter, probably with their sensitive snouts. They fed on both animal and vegetable matter. They were active from dusk. When hunted, the solenodon would push its head under cover and crouch so that it was easily caught.

OTTER SHREWS
Family POTAMOGALIDAE

The **Otter Shrew** resembles the common otter in size and way of life, but it does not have webbed feet. It is one foot long with a vertically flattened tail of about the same length. At certain angles, its dark-brown fur has a purple bloom.

The otter shrew is found in West Africa. It is a swift, agile, graceful animal, a hunter of fish and other aquatic animals, which it catches in the water. It comes ashore to devour its prey. Unlike the otter, it swims with a snake-like movement of its body without using its limbs. Its tail acts as a rudder. Like so many other rare and interesting

species, the otter shrew is in danger of extinction. It is hunted by both the black and white inhabitants of West Africa and since it gives birth to only two young, the birth rate can barely keep pace with mortality. It is interesting to note that the otter shrew was once classified with the carnivores, although it is in fact a true insectivore.

Otter Shrew

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GOLDEN MOLES
Family CHRYSOCHLORIDAE

Although they resemble the common mole in shape and habits, the Golden Moles are more closely related to the tenrecs. The hands have four claws, a tiny inner, an enormous second, and two small outers which fit into the hollow of the second. The fur of the golden mole has a beautiful metallic sheen. On the tip of the snout is a bare button of hard skin, a useful adaptation for a burrowing and digging animal. The golden mole prefers sandy ground which affords easy digging. It is found from South Africa to the Congo.

Best known is the **Cape Golden Mole**, which burrows in gardens just under the surface of the soil, hunting worms and larvae. Unlike the common mole, it puts up no "fortresses".

Cape Golden Mole

HEDGEHOG
Family ERINACEIDAE

Not all the members of this family have the formidable bristling defences of the Common Hedgehog. Some of them have no more than rough hair. The true hedgehogs

possess a special muscle, forming a sort of helmet over the body, which enables them to coil into a ball. They have thirty-six teeth.

The **Common Hedgehog** is found throughout the Palearctic region, up to 63° N, and seventeen subspecies have been described. It was introduced to New Zealand towards the end of the nineteenth century and is well settled there.

The most notable feature of the common hedgehog is its protective armour of dark-brown quills, which are about three-quarters of an inch in length. The armour covers its upper parts from the crown to the root of the tail, but the underside is unprotected, being coarsely furred like the head and tail. Its spines are modified hairs and do not appear to be moulted in the ordinary way.

A full grown male hedgehog is about a foot in length; females are slightly smaller. Males weigh up to $2^3/_4$ pounds, females up to 2 pounds, or slightly more. There is no way of sexing hedgehogs merely by looking at them.

Most hedgehogs are found in a great variety of habitats except very high ground (they have been found in the Alps among dwarf mountain firs at a height of 6,000 feet), very wet ground, or in tall closed forest. They like farmlands with copses, open woodland, hedgerows, scrub, rough pastures, country gardens and orchards. When hunting, the hedgehog makes no effort to move about quietly, so it is often possible on a spring or summer evening to find one by listening for it. It rustles in the leaf litter and snorts and snuffles as it goes along. Of course it is well protected by its armoury of barbs, and coils itself into a ball as soon as danger threatens. The array of 16,000 quills is sufficient to deter most enemies, including most dogs, but the badger can tear a hedgehog open and the fox has his own way of forcing one to uncoil.

If you stand by a coiled hedgehog and keep quiet it will soon open up to go about its business, but if you make a sudden movement it will lower its head, bringing its brow quills forward, and coil tightly again if you move to handle it.

Hedgehogs are crepuscular and nocturnal, which means that they come out at dusk and hunt from then right through the night. They spend the daylight hours asleep in their lair. As a rule the hedgehog hunts at a leisurely pace, but will make short quick rushes when it has to. It weaves and snuffles about, poking into every corner, turning over fallen leaves and sticks, and seeking in grass tussocks. It will raise its snout and sniff the air in a half-circle, bear-like. It eats a great variety of food; insects, larvae, worms, centipedes, spiders, snails, lizards, mice and snakes. It also eats carrion and sometimes the eggs and young of ground-nesting birds. Fruit is taken occasionally and according to the record, beech mast and acorns. In captivity it becomes very fond of milk.

Common Hedgehog

Professor Hertar, who is well-known as a specialist on the European hedgehog, has done much work on the quantity of food it will eat. He found that a female hedgehog, weighing $1^1/_2$ pounds consumed in one night 3 ounces of cow's milk, a sparrow weighing nearly one ounce and $4^1/_4$ ounces of young birds. This, of course, represents merely the weight of food given to hedgehogs by Professor Hertar, and is no guide at all to the type of food a wild hedgehog would be eating. Another hedgehog, fed entirely on meal-worms, consumed 4 pounds in ten days. The diet suited this animal so well that it put on $16^1/_2$ ounces in weight during the period. When the same hedgehog was afterwards fed entirely on sparrows it ate $3^1/_4$ pounds and lost nearly 2 ounces in weight. Insect food is quite evidently more nourishing than birds, and one can conclude from this experiment that insects form a very large part of the hedgehog's diet in the wild state.

The sense of smell is highly developed in the hedgehog and is probably the main one used in hunting, but hearing is also good and the beast quickly reacts to noise. Sight is less important, but the animal can see all right over a short distance.

It can safely be said that the hedgehog will kill and eat anything he can catch and hold. So, at different times, his prey includes voles and mice, frogs and lizards, small rabbits and rats. He is able to break only small eggs and could not break an egg of the domestic fowl unless there was a crack in it to begin with. He is blamed for eating the eggs of pheasant and partridge and there is no doubt that he sometimes does, but his predation on the eggs of these game birds is insignificant. Sometimes the hedgehog will find his way into a poultry coop and perhaps even kill the sitting hen; but predation like this is most exceptional. When he catches large prey such as a frog, a vole or a young rat, he shakes it vigorously, then he holds it down by his front paws and begins to eat. He is a noisy feeder and a person standing by could hear the cracking of jaws or the crunching of shells apart from the smacking noise made by the hedgehog himself. He drinks a great deal of water, but a captive hedgehog offered water or milk will usually choose milk.

The hedgehog is considered a great killer of adders, but some animals will not touch an adder and many are bitten on the face by them. A hedgehog so bitten may recover, the seat of the bite betrayed for some time by a hard swelling. But many die in convulsions within a few hours, or a day or two, of being bitten.

Apart from the badger and the fox, the hedgehog has other enemies, notably dogs, but not so many dogs master the art of dealing with the armoured ball. Man is still a considerable predator, especially by trapping and shooting in the interests of game birds and, unintentionally, through the agency of motor cars and other vehicles on the roads. In modern times, the motor car, in Western Europe at least, is a main factor in hedgehog mortality.

In the autumn, the hedgehog puts on fat to prepare himself for hibernation. Once he is asleep his temperature falls, his breathing slows down and his heart beats become a tick-over. Thus, he ekes out his stored fat until the spring. Hibernation begins in October/November and lasts until March/April. A hedgehog with a sufficient store of fat usually sleeps without a break. Intermittent sleep is a sign of a beast not properly prepared for hibernation. Hedgehogs seen on foot in mid-winter

Hairy Hedgehog

North African Elephant Shrew

Short-eared Elephant Shrew

will almost certainly die unless the weather continues mild and food is available.

Many legends have grown up around the hedgehog. He has, for example, been credited with the ability to suck cows. He does not and could not suck a cow, but there is an obvious association between cows and hedgehogs which is responsible for the legend. Insects are often plentiful in the places where dairy cows lie in the fields in summer, and the hedgehog frequently seeks in such places for prey. Milk from the overstocked udders of cows will sometimes leak on to the grass and this the hedgehog will lick up when he comes across it. He is, therefore, often seen near cows which are lying chewing the cud, so it is easy to see the origin of this legend.

Another belief was that he could gather apples and pears on his spines. He was supposed to gather the fallen fruit by rolling on it. This he does not do. He was also supposed to climb fruit trees and loosen the fruit by vigorously shaking the branches. He does not do this either. Nevertheless, it is a fact that he does sometimes eat fruit and you will see a hedgehog often enough with material of one kind or another adhering to his quills, part of his bedding for example.

A number of species of hedgehogs live in Europe, Asia and Africa, all very similar in appearance. They form the true group of hedgehogs, the sub-family Erinaceianae: the other sub-family Echinosoricinae is the so-called **Hairy Hedgehogs** which have no spines and are found in East India, Thailand and Malaya where there are no true hedgehogs. The hairy hedgehogs resemble shrews, but have long tails like a rat and are much bigger than either.

ELEPHANT SHREWS
Family MACROSCELIDIDAE

These are rat-sized African insectivores with the typical trunk-like shrew snout, long hind-legs and prominent ears. The scaly tail, which is almost hairless, is less than the length of the body. All the species in this group are diurnal and are found mainly in arid regions of Africa. The **Short-eared Elephant Shrew,** which inhabits South and East Africa is mouse-grey in colour and measures nearly 10 inches in overall length. The **North African Elephant Shrew** is found in the Atlas mountains.

SHREWS
Family SORICIDAE

The shrew is a mouse-sized animal with a soft coat and a flexible trunk-like snout. Compared with mice it is short-legged and cannot run very fast, but the main distinguishing feature is the snout. No mouse has a snout as long as a shrew's.

Shrews are active all the year round as well as round the clock, and hunt their prey under the snow when the hedgehog is hibernating. They are mostly noisy animals and are often betrayed by their voice which is like the chirp of a cricket.

Shrews prey upon insects, molluscs and worms, but will attack small invertebrates like frogs, and feed upon any dead mouse or vole they come across. Owls and kestrels prey upon the shrews, but stoats and weasels are deterred by the musky odour and will eat shrews apparently only when the alternatives are shrew or hunger. Nevertheless, furred predators continue to kill shrews, presumably by mistaking them for mice in the first instance.

The family of the Soricidae is made up of two groups of shrews, those with red teeth and those with white. In the former, the tips of all the teeth are reddish-brown and this colour can be seen quite easily by pressing up the fleshy snout and lips. In the latter group, the teeth have no coloured tips. In the first group are the Common Shrew, the Pygmy Shrew, the Alpine Shrew, the Water Shrew and the Mediterranean Water Shrew. In the second group are the White-toothed Shrew, the Lesser White-toothed Shrew and the Bi-colour White-toothed Shrew.

The **Common Shrew** is found in Europe, through Asia and up to the Arctic Circle. It measures between 4 and 5 inches in total length, of which $1\frac{1}{2}$ inches, or a little more, is tail. Adults weigh under half an ounce. The upper fur is dark in colour, varying from sandy-brown to dark-brown; the under parts are greyish-white. The tail is dark above and light on the underside. There are two moults in the animal's life, one in autumn and one in spring. The summer coat is paler and shorter than the winter one.

The common shrew has a short life and does not survive beyond its second autumn. In this period females will rear two or three litters in a season, although some may produce only one. The number of young in a litter varies from one to ten, but the average is about seven. The period

of gestation, according to the most recent research, is twenty-one days.

For the first three days of their lives, the young are flesh-pink in colour, only the tip of the nose being darker. After the third day, their fur begins to grow and they become darker in colour. Their eyes open after seventeen days. For twenty-six days, the young suckle their mother, but by the sixteenth day, they are beginning to take animal food as well. They leave the nest only when they are strong and active and it is rare to come upon a young, helpless shrew in the open. As a rule, the young do not reach maturity until the spring, when they begin to breed, but where feeding conditions have been especially good, females from early litters may breed precociously in the year of their birth.

In soft ground, the shrew can dig its own burrow but it usually prefers to occupy the abandoned burrow of a mouse, vole, or mole. It makes its sleeping nest of moss, grass and leaves, or anything else that is lying to hand. This is not nearly so well constructed as the female's breeding nest, which is a more substantial and more closely woven affair. Nests can be found in holes in the ground, in clefts between stones, in rotting tree stumps, under a tree root, in a hedge bank, under boards or flagstones, or in a half-buried flower pot. Although nests are usually globular, captive shrews seem satisfied to make flat ones inside containers.

The shrew can climb well and swim well and will do either for no apparent reason.

The common shrew is found wherever there is suitable ground cover, from sea level to the tops of mountains. Being a hunter of the leaf litter, it is found in woodlands, moorlands, cultivated fields, rough pastures, hedgerows and sand dunes. It has been recorded up to several thousand feet above sea level.

The appetite of the shrew is prodigious and it will eat up to and over its own body weight in twenty-four hours. Although an insectivore and a carnivore, the shrew takes a small amount of vegetable matter and this can be supplied to captive animals in the form of oatmeal. The main prey consists of invertebrates captured in the leaf litter; earthworms, beetles and their larvae, flies and their larvae, moth larvae, grasshoppers and spiders. Wood lice are readily eaten and the shrew will feed upon any small, freshly-dead mammal it comes across. Centipedes are not much favoured.

Because of its need for food at short intervals, the shrew's life is divided between sleeping and eating. If starved for a few hours it dies, and because of this, many are found dead, or dying, in vole traps. They are also highly nervous animals. For these reasons, they are not easily kept alive in captivity for any length of time, except by experienced workers.

When hunting, the shrew moves great heaps of litter and is quite capable of dragging into cover a vole three times its own weight. Its pin-head eyes are of little use to it when it is hunting, nor is its sense of smell highly developed. It cannot smell a prey until it has contacted it with its sensitive whiskers, and it finds most of it almost by falling over it. But the shrew can locate a powerful scent at close quarters and will turn aside to seek it, probing with its snout and sensitive vibrissae.

Captive shrews, especially females with young, will store surplus prey after disabling it by biting. An earthworm, for example, is pricked along its entire length before being stored. It is more than likely

that all wild animals behave in this way. All shrews examine captured prey first of all by smell, then they will taste it before accepting or rejecting it. The shrew squeaks as it hunts, and can be heard at all hours, especially in spring and early summer when the breeding season is at its height. Several shrews together mean more excitement and more squeaking and the animals can sometimes be seen if the ground cover is gently parted over their heads. There is often considerable quarrelling among adults and, therefore, much noise. But a party of shrews uttering only squeaks of pleasure will almost certainly be females with young.

Outside the breeding season, the shrew is solitary, but it is always quarrelsome and often aggressive towards its own kind. Contact between rivals often means a pitched battle, but the battle is usually brief and serious damage is rare. A fight to the death, where it does occur, is usually between males competing for a female in breeding condition. However, fights are likely to be territorial, with the weaker animal retiring before he is damaged.

The **Pygmy Shrew** is smaller than the Common species, measuring from $3^1/_2$ to $4^1/_4$ inches in length, of which $1^1/_2$ inches, or more, is tail. It weighs from one-tenth to one-fifth of an ounce. Although it closely resembles the common shrew, the pygmy's tail is longer proportionately and absolutely, being about two-thirds of its body length.

The pygmy is widely distributed but far less common than the previous species and does not become more numerous even in areas where the other is absent, as in Ireland.

Like the common shrew, the pygmy leads an active life, round the year and round the clock. Sometimes it stores food. Pygmys born in the spring and summer of one year are all dead by the summer and autumn of the following year.

The nest of the pygmy usually is made of dry grass or moss and hidden under a stone, in a tree stump or a grass tussock, or under an old wall. Sometimes one will make its nest in a greenhouse. Unlike the common shrew, it does not burrow but uses instead the ready-made burrows of mice and voles.

The **Alpine Shrew** is found in the Alps, the Pyrenees, the mountains of Central Europe, the Carpathians, and the Balkans,

Common Shrew
European Water Shrew
Bi-colour White-toothed Shrew

but very little is known about its biology. A related species is found in the Caucasus in the Soviet Union. The alpine shrew frequents the banks of mountain streams in forested country up to the high belt of dwarf fir trees.

The **Water Shrew** is found all over Europe and in Northern and Central Asia and is the largest species. Overall length ranges from 4 to 6 inches, of which $1^3/_4$ to $2^1/_2$ inches is tail. Although it is usually found by pools and streams of clear, unpolluted water, it can live and breed in woodland far from water. This tendency to move from water to woodland has been observed in widely separated places.

The usual colour of the water shrew is black above and white below, with a clear flank line of demarcation between the zones. Sometimes the black becomes dark brown, or has a brown bloom, and the under fur can be greyish-white, or even cream. The tail is dark brown on the upper side and white underneath. On the underside there is an obvious keel of hair. Ears and eyebrows are often tipped with white. Melanism is fairly frequent in this species and the darkest types are dark all over. Albinos have also been recorded.

The nest of the water shrew is usually built in a bank not far from water and is closely constructed of grass and withered leaves. The nest has upper and lower exits in the banking. The breeding season is from April to September and most of the young are born in May and June. The gestation period is twenty-four days and litter size is five or six. The young are weaned at the age of one month, but are not mature until the following year. Two litters in a season are usual.

When living in woodland, or some distance from water, the water shrew probably eats much the same prey as the common shrew. In its more typical habitat of streamside and pool, it eats crustaceans and snails, small fishes and frogs as well as insects. It is often accused of eating fish ova and it does so at times, but the effect of such predation is completely insignificant. Nowadays, few anglers have any quarrel with the water shrew. Old books on zoology credited it with killing large fish, such as the carp. This belief arose because, from time to time, a shrew had been observed feeding on a fish of this size and it was assumed that it had killed it.

Although it is often found in woodland ditches, far from pond or stream, the water shrew is typically a waterside species, living in bank burrows and hunting the waterside river shallows. For this life it is perfectly adapted, having a tail that gives the sweep of an oar and bristles on its feet to act as webs. It swims with a lateral movement of tail and body and paddles with alternate strokes of its feet. It is an excellent diver and swimmer. Although it can enter the water quietly at times, it usually dives with a distinct *plop*. Its fur is thick and waterproof and does not soak even if a dead shrew is shaken about in the water. Air bubbles trapped in the fur give the shrew a silvery appearance when it is swimming underwater.

Like the common shrew, the water shrew squeaks as he hunts by the waterside. When he is hunting the stream bottom, he swims like a newt, turning over pebbles with his forefeet while he seeks his prey. On the surface he will swim after floating insects or come up underneath them and swallow them in the way he, himself, is sometimes caught by the pike.

The pike is, in fact, a major enemy of this species. Other predators are cats, foxes, stoats and owls, and owls certainly eat it.

On the other hand, the water shrew is faster than the other species and moves with ferret-like bounds. It hunts in the ground litter like the common shrew, heaving and burrowing as it seeks earthworms, spiders and wood lice. Like the others, it hunts round the clock and round the year and can be seen whisking in and out of snow drifts when the streams are frozen over.

The water shrew can be kept in captivity more easily than the other species, but even with the best of care it seldom lives for long. It needs a well-shaded cage with moss, stones and water, but even under the best conditions, many die.

Brehm has written of the water shrew that: "relative to its size the water shrew is a frightful beast of prey. It does not only feed on insects of all kinds, particularly water insects, but even on worms, small molluscs, crustaceans, newts, fish, birds and small mammals. If it catches a mouse in its burrow, the mouse is lost . . ."

This is a highly coloured way of saying that the water shrew will eat whatever it can catch and kill.

Lockie and Stephen have described the behaviour of a family of water shrews living by a Scottish stream: "We found a nest of water shrews beside a narrow water channel diverted from the main stream to supply the mill wheel. There were five small young in the nest which were not moved by the mother although the site had been uncovered by a terrier. The nest was a ball of leaves and grasses with several tunnels leading upwards to the top of the bank and one leading down to the water.

"The shrew had several feeding places on her hundred yards of water channel and here we found caddis cases, bits of shell and other remains of prey. She would work a stretch of banking, shaking the vegetation, then enter the water to swim or dive. Several times we watched her swimming the bottom and kicking up a cloud of ooze when she pounced. She could sink from the surface to the bottom like a dipper and was no more difficult to watch once she had been seen.

"The young, when they became active, played around the tunnel entrance on the bank top, chasing, grappling and squeaking, and fairly shaking the grass stems. Then, one day, there were six shrews in the water swimming, diving and playing and actually leaping into the air. This play spell took place early in the morning and lasted for a few minutes, then all paddled to the bank and disappeared. We did not see the family together again.

"The shrews on that stretch of water caught minnows and, one morning, we watched a shrew coming ashore with one. It drew the body under the bank overhang, bit it along its length, held it down with its forefeet and began to chew off the tail fin. It then ate from the tail fin forward, devouring about one quarter of the prey at one sitting. The remainder was dragged further into cover and left there."

The **Mediterranean Water Shrew** is found mainly near swamps, on low ground, on high ground and sometimes even in the mountains. It is recorded in forests far from water and appears to be even less dependent on water than the water shrew. Not much is known about its general habits and biology.

The **White-toothed Shrew** and the **Lesser White-toothed Shrew** like a dry habitat and avoid closed-in woods. In some parts of Europe, they will move into farm-houses for the winter and such indoor

shrews are sometimes caught in traps set for mice. Generally speaking, they are found on heathlands, areas of dry bracken and bramble, farmlands and rough pasture. The **Bi-colour White-toothed Shrew,** one of the many species, is common in South and Central Europe.

In behaviour and breeding biology, the white-toothed shrews show certain marked differences from the other group. As has been seen, the young of the other shrews leave the nest when they are well grown and active. Young white-toothed shrews, on the other hand, do not remain for long in the nest and leave it when they are under one inch in length. It is when the young are at this stage that we can observe the habit of caravanning. The mother leads the procession in line and each young animal hangs on by its teeth to the hairs, or tail, of the one in front. It is not known why these caravans are formed, although it has been suggested they may have something to do with the shrew's weak eyesight. When they are being led in this way, the young shrews take no notice of anything but go wherever their mother leads them. Everything she does they do. Although at all other times their sensitive snouts are constantly aquiver, there is no such movement during caravanning. The young animals cling on to their mother and each other so firmly that they move over obstacles like a dragged chain. If the mother is lifted from the ground, the whole chain of young is lifted with her. The young form such a chain whenever they find themselves in any difficult situation — for instance if they are too far away from their nest to smell it — and they behave in this fashion until they are three weeks old. This behaviour has been observed and photographed only in the case of the lesser white-toothed shrew and the bi-colour white-toothed shrew.

The smallest mammal in the world is **Savi's Pygmy Shrew.** It is found in the Mediterranean area, in Trans-Caucasia, and in Turkestan. It is $2^1/_2$ inches long, including the tail of one inch, and weighs only one-tenth of an ounce. It likes damp places close to water and is never found in dry habitats as is frequently stated in older books on the subject. Most of what is known about the existence of Savi's pygmy shrew has been ascertained by examination of owl pellets in which its teeth, fur and bones have been found.

MOLES AND DESMANS
Family TALPIDAE

Moles differ from shrews in their dentition and the formation of their skull, which has a zygomatic arch. In moles, the eyes and ears are poorly developed and in some species the eyes are even covered with skin so that they are completely useless for vision.

Desmans live above ground, but the members of the three other groups live underground. The burrowers are highly adapted for their way of life, having cylindrical bodies with strong claws on their forefeet for digging.

An exception is the genus Uropsilus which lives on the frontier between Tibet and China. It is found only above ground and its forefeet are not adapted for digging.

Its skull is like that of the common mole. This genus, therefore, forms a kind of link between the shrews and the moles.

Desmans are bigger than shrews. They have stocky bodies, short necks and webbed feet. Their hind-legs are longer than their forelegs. Their tails are round at the base, flattened at the tip, covered with scales and sparsely haired. Their snouts are even longer than those of the shrews, being still more trunk-like and highly mobile. The desmans use their snouts for examining all objects of prey. Musk glands on the underside of the tail give off a sharp distinctive odour.

In the Pyrenees, Northern Spain and Portugal, we find the **Pyrenean Desman.** It is about 10 inches long, half of which is tail. Despite its secretive, retiring ways, this species is rare and becoming rarer. Fishermen persecute it. It is often caught in their nets. It does not live long in captivity.

The **Russian Desman** is a much larger species, measuring $16^1/_2$ inches overall, of which $6^1/_2$ inches is tail. This species inhabits great river basins with luxurious vegetation. It preys mainly on insects, molluscs, leeches, crustaceans and fish but eats some vegetable matter as well. It lives in burrows which it reaches by way of an underwater entrance. Its nest is, of course, above water level. For temporary shelter, the desman will dig out simple burrows but the burrows near the nest are numerous and extensive. Up to five desmans will live in the same burrow. Males are always more numerous than females. There are two litters of young each year from July to August and from November to December, the usual litter size being five.

The desman has been introduced into various parts of European Russia because of its value as a fur bearer. Originally, it inhabited the lower Volga and the Don and the Central and Upper Ural.

Forty years ago, poachers and fishermen had almost completely exterminated the Russian desman and the Soviet government had to take strict measures for its protection. Shooting was forbidden and large reservations were set aside where the species could live in peace and build up its numbers. Between 1929 and 1940, four thousand desmans were introduced into various regions. Even in its original habitat, the desman has again increased in numbers to its former level. Thus, in 1946,

Pyrenean Desman

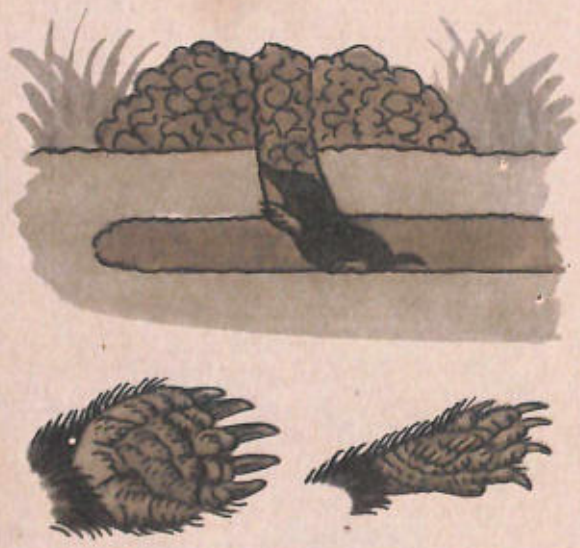
Russian Desman

the Soviet government was able to permit hunting again, but such hunting is now strictly regulated and any poaching is severely punished.

The **Common Mole** is found all over Europe as far north as Southern Sweden; eastwards it is found through the Caucasus to Bajkal on the river Lena, and in Northern Siberia, where it appears in places even beyond the polar circle.

Moles vary in length from 5 inches to $6^1/_4$ inches, the tail being between one inch to nearly $1^1/_4$ inches. Weight also varies greatly, animals from fertile regions being bigger and heavier than those from infertile areas, or sandy or mountainous regions. Mountain moles are always smaller than lowland ones. Males are larger than females.

The mole's coat is purplish-black and glossy. The forelegs stick out from its barrel-shaped body like two great shovels. Palms face backward and the toes are equipped with short, strong claws. The eyes are no bigger than poppy seeds and can only be seen if the surrounding fur is pressed back. In some moles, the eyes are covered with skin. The nostrils open under the snout.



How the molehills are made (top). Fore foot (bottom left) and hind foot (right) adapted for scraping

The mole occurs almost everywhere, from the lowest ground to the highest alpine meadows. Of course it is most numerous on low ground with a rich soil providing a good food supply. It is, therefore, common in arable fields, pastures, parks and gardens. It is also found in deciduous woodland and re-seeded hill pastures, but it does not like peaty moorland, coniferous forests or saltings liable to flooding. Rocky and sandy ground are least attractive to it, but it will live in swampy ground so long as it can find a few areas which are not flooded.

Like the shrews, the mole is a gluttonous animal and has to eat round the clock. It therefore spends much of its time hunting for food. Its hunting range is marked by the numerous molehills pushed up during burrowing operations. New molehills appear as the animal extends its tunnelling. Some molehills are quite small but others are up to three feet in diameter.

Sleeping nests and breeding nests are built underground, the usual material being leaves and grass which are used as gathered and not shredded.

The breeding nest is very often an enlargement of a tunnel, the mole pushing the soil to the nearest upshaft to dispose of it. A nest of this kind is not betrayed by anything immediately above ground. Breeding nests are also found under the so-called fortress heaps. Wherever the nest is sited it has a complex system of tunnels round about it. The tunnel system in a fortress heap gave rise to the name "fortress" because it looked so carefully plan-

ned, but, in fact, the lay-out varies considerably.

The mole's tunnels vary in diameter to some extent but most of them are quite a tight fit and contact between the mole and the tunnel keeps the animal's fur squeezed clean. Tunnels under moleheaps are about two feet below the surface of the ground. Shallow burrows are also driven, which are betrayed by a ridge on the surface or by cracks in the greensward. These shallow burrows are driven by moles in rich ground and, especially, arable ground, but they are also made by dispersing young which also make simple open furrows. Deep tunnels of long standing are used by succeeding generations of moles to get from one field to another, for example, under a ditch or a lane, long after the mole-heaps on the surface have been flattened or otherwise dispersed.

Burrow systems are occupied by a single mole of either sex and the only association between one mole and another is between male and female in the breeding season and between the female and her young. Once a family is dispersed, all moles become solitary and quarrel with other moles on sight. But there is some evidence that when the master mole of a territory is asleep, less important animals will use the burrow system. Fights between dominant males can be fierce and many an old mole wears scars as the result of such encounters.

The breeding season is in the spring and is over by June. The number of young at a birth varies from three to four in Great Britain, up to five or six in Russia. The gestation period is about four weeks. The young moles are hairless at birth and about the size of beans. The mother mole is attentive to her young and will move them from the nest at the slightest threat of danger. After about five weeks the

Common Mole

young disperse and the breeding nest is deserted. The nest harbours a variety of parasites, particularly very large fleas which are about six times the size of those found on dogs or people. Although they jump vigorously when a nest is disturbed, they do not suck human blood.

Young moles during dispersal are attacked by many predators, including kestrels, owls, crows, ravens, stoats and weasels. During dispersal, young animals will dig through roots and very hard ground but when they reach rocks or made-up roads, they have to surface to cross. Predation at such time can be high. Dispersing moles will even dig through the mud of dried-out fish ponds. Water is no problem as all moles swim well. During flooding, when it is driven out of its tunnels, it will swim considerable distances, including wide streams. This explains why moles are so often found on river islands.

Other predators are the stork, buzzard, badger and fox. In Europe, the wild boar has been recorded digging for moles. Despite the fact that mole catching is not now an economic proposition, man still remains a considerable predator, using worms poisoned with strychnine. The weasel hunts the mole below ground and will use its tunnels when moving across a field.

The mole feeds mainly on earthworms and on the larvae of beetles and flies, but

Star-nosed Mole

he also preys to a considerable extent on slugs and myriapods. Like the shrews he also eats a little vegetable matter. The proportion of prey species eaten varies at different times of the year, earthworms making up the bulk of the food in winter and falling to half in summer when insect food becomes more plentiful. Like the shrews, the mole has to hunt throughout the year and round the clock and shortage of food supply can retard the growth of young. In times of plenty, the mole will store surplus food and many stores of earthworms have been found. Earthworms are not killed; they are paralysed by a bite. Thus, although alive, they cannot move and being alive they do not rot. One such store, recorded by Skoczen contained 470 earthworms.

Because he spends practically all his life underground the mole has little need of good eyesight, and, in fact, his eyes are of little use to him. His sense of smell, like that of the shrew, operates only at close range and is otherwise poor. His hearing is good, but touch is the most important sense and he is highly sensitive to soil vibrations. He has highly sensitive hairs on his chin and muzzle and the tip of his tail.

Like all animals that make some impact on human affairs, there has been much discussion about whether or not the mole is useful to man. It has been said that by preying heavily on earthworms they denude the soil of an important species. On the other hand, it has been argued that their burrows aerate and drain the soil; in which case, the mole is performing a useful function. Mole-heaps can be a nuisance in hay fields and corn fields, and, in the garden, a burrowing mole can heave up rows of seedlings. A mole in the garden need be no problem because it is easy to catch him in his nest, or dig him out with a spade and transplant him at some distance.

In Mediterranean countries and in the Caucasus, there are smaller relatives of the common mole.

The **Mediterranean Mole** has its eyes completely covered by skin. In 1946, two specimens of this species were captured in the Tatras of Czechoslovakia, the only ones ever recorded there.

The **Eastern Mole** is a North American species. Although it has webbed toes, it is a land species and a more accomplished burrower than the common mole of Europe.

The **Star-nosed Mole** has a star-shaped tuft, or growth, on the end of its nose. Apart from this distinctive feature, it differs from other moles in having a long, strong tail which is almost as long as its body.

ORDER: DERMOPTERA

Flying lemurs are small animals no bigger than a cat and they are such striking creatures that they could not possibly be mistaken for anything else. Their outstanding feature is the wide fold of skin, which, starting from the neck, joins the front and hind-limbs and runs from the toes on the hind-feet to the tip of the tail.

As in the bats, these so-called wings are formed of membrane but the lemurs do not have the bat's long fingers. The wings, therefore, are not wings at all but mere gliding membranes as in the flying squirrels. The skin fold is more like a parachute which, when spread, softens the lemur's fall and helps it to make long flying leaps from tree to tree, or from a tree to the ground.

Unlike certain flying marsupials and rodents with a smaller parachute arrangement, the tail of the flying lemur is not free. As we have seen, it is attached to the hind-limbs. The parachute of the flying lemur is the most perfectly formed.

It has been shown that the flying lemur can, with the help of its parachute, volplane from a tree top for a distance of sixty, or seventy yards, losing only about thirty feet of height in the distance. This means that the lemur can leap from the top of a thirty-foot tree to the base of another tree nearly seventy yards away. It can then climb into the tree and launch itself again, thus travelling considerable distances without covering any ground.

Tree tops are, in fact, the real habitat of the flying lemur. On the ground it moves in jerky jumps but it is only rarely seen there.

Leaves, buds and fruits are its food. The animal feeds hanging upside down, pulling the food towards its mouth with its forelimbs. In this upside-down position it spends a great part of its life, and when asleep it is difficult to see because the outer surface of its body looks very like the lichened bark of a tree.

As a group, the flying lemurs fall between insectivores and the bats, with both of which they have much in common; but the lemurs have highly specialised teeth, the like of which are found in no other species. The teeth resemble the teeth of a comb, or a row of files. Apart from using them to slice their food, the lemurs use them as a comb for cleaning their fur.

Flying lemurs have small, elongated heads and round, fur-covered ears. They have large, dark eyes and are crepuscular, or nocturnal, in habits. They sleep high in trees during the day, hanging against the bark of a branch or trunk. Their sharp, curved claws enable them to climb with ease and safety. Their fur has a special dust which will stick to the hands if one touches the animal.

FLYING LEMURS
Family CYNOCEPHALIDAE

The **Malayan Flying Lemur** inhabits the Sunda Isles of the Malaya archipelago, the Moluccas and the Philippines. In the vernacular of these places it is variously known as the colugo, cobego or cubuc.

This species measures about $23^1/_2$ inches from the tip of its nose to the tip of its tail. Its fur, which has no particular commercial value, is brownish-red above and brownish-grey on the underside.

Junghuhn writes about his encounter with a Malayan flying lemur as follows:

". . . we heard just a single squeak, but it was such a peculiar and fear-laden sound that we thought a child had cried out or that a wounded man had sighed. Occasionally, horrifying and ugly sounds broke through the silence of the night. The natives huddled closer round the fire. Fear of ghosts silenced the merry talk. The spirit or unhappy creature whose voice was like a terrified call in the distance appeared before our eyes, volplaning above our heads. It was the flying lemur uttering those strange sounds as it volplaned from tree to tree."

Malayan Flying Lemur

This writer confirms that the flying lemur bears only one young. He saw a female which had a tiny, slender, bare-skinned and blind young hanging from her breast.

The flying lemurs that inhabit the Philippines are slightly smaller than the Malayan type and form a separate subspecies.

Moseley has given an account of their biology. Accompanied by a native guide, he visited an area in Basilan where he wanted to shoot some flying lemurs. There were a few trees in the area, the remnant of a forest, and after a long search Moseley glimpsed a flying lemur in one of the tree tops. It was hopping about a strong branch with short jerky movements. When he had shot it down, he found that it was a female with a young one at her breast. As the nearest tree was over forty feet away, the animal must have volplaned that distance because lemurs would never travel so far on the ground. Moseley was told by his guide that lumberjacks catch many lemurs while tree-felling.

ORDER: CHIROPTERA

Bats have a great deal in common with insectivores. There are 980 known species in the world, most of them small animals, although the biggest has a wing span of five feet.

Bats possess the power of true flight, but, although they have wings and are at home in the air, they have nothing in common with birds. Their body is covered with fur and they are true mammals, giving birth to living young which are nourished by the mother's milk. The forearm and all the fingers of the hand, except the thumbs, are greatly elongated. A fine membrane, covering forearm and fingers, and joined to the body and the hind-limbs, forms the wing.

Bats do not like light; they fly at dusk and during the night and roost by day in hollow trees, rock crevices, caves, cellars or abandoned houses. Tropical bats sleep through the day in leafy tree tops where they hang upside-down from a branch.

The fruit-eating bats are restricted to the tropics and sub-tropics where they can find enough food all the year round. The insectivorous bats are found much farther north and can stand the harsher climatic conditions because they sleep through the winter. The fruit-eaters are not found in either Europe or America, but America is the home of the blood-sucking species. Insectivorous bats have sharp teeth like the other insectivores. Fruit-eating bats have much simpler teeth.

Long, long ago, observers noticed how bats were able to navigate among the branches of trees and other obstacles without ever colliding with them, and that they could fly in dark caves and mine galleries and find the exact spot where they wanted to roost. Many animals, owls for instance, have eyes adapted to make use of the slightest amount of light, but in absolute darkness they are unable to see. Bats, on the other hand, have very tiny eyes which are of little use to them at dusk, let alone in the dark. How, then, do they navigate?

At first, naturalists put it down to a special sense. Then the Italian Jesuit, Spallanzani (1729—99), carried out some experiments with captive bats and found that they could navigate accurately in a dark room, across which he had drawn numerous fine threads. Even blinded bats were able to navigate without once touching a thread. Obviously the bats were not flying by sight. Spallanzani also proved that they were not using any sense of smell. Later, the Swiss worker Jurini, of Geneva, proved that bats lost their power of orientation if their ears were sealed. The researches of Spallanzani and Jurini were forgotten about until 1920 when Hartridge suggested bats might emit short-wavelength squeaks, or pulses, echoes from which would be reflected back from objects in their path. This was later proved beyond all doubt by Griffin and Galambos in America and it is now standard knowledge that bats navigate by echo location. In the long interval between Spallanzani's experiments and Hartridge's discovery, it was widely believed that bats navigated by some tactile sense; for example, the wing membrane, the tragus or the nose-leaf (a lobe of skin attached to the ear trumpet at the base, which looks like a small inner ear).

It is now known that bats emit two kinds of squeaks. There is the normal voice which can be heard by most human ears. For purposes of echo location, the bat emits short-wave

squeaks which cannot be heard by the human ear. Besides emitting these ultra short-wave calls, the bats can hear them. When flying at night they emit them constantly and although the sounds cannot be heard by the human ear, the bat's ear catches the echo of its voice reflected by any obstacle in its path. Thus, they actually hear obstacles, as it were, and they are able to judge the distance of the obstacle by the sound thrown back by it. They can hear a tree in their way, they can hear the entrance to a cave, they can hear the water when they swoop down to a pool to drink. It is a very wonderful arrangement and one unknown in any other group of animals. In addition to this, the bat can hear normal sounds perfectly well, such as the buzzing of insects. Experiments with captive bats have revealed the high development and sensibility of their ears.

Not all bats feed on insects. As we have already seen, some are fruit-eaters. But there are other species, such as the American vampires, which attack vertebrates and suck the blood of warm-blooded animals. Some tropical species feed on the nectar of flowers and have a long proboscis for gathering it. They pollinate flowers just as insects and Humming birds do, and there are some plants that can be fertilised only by these bats. A few bats feed on fish and have long hind-legs with which they catch small fishes as they swim under the surface of the water.

When giving birth to her young the female bat grips with the thumbs of her forelimbs as well as with her hind-feet, so that she is in a horizontal rather than a vertical position. Then, by curving her tail, she forms a kind of pocket into which the young one falls at birth. Immediately after birth, the young one instinctively climbs up the mother's fur and fastens on to her nipple. At birth young bats are hairless and blind. The wings are still small and undeveloped, but the hind-legs are large and enable the young one to hang firmly on to the mother's body, even when she is in flight.

Compared with other mammals of the same size, bats are long livers. A mouse, or vole, seldom lives for more than three or four years in its natural environment, while one bat of a very small species lived for twenty-three years. It is not improbable that some of the very large bats live to an even greater age. One fruit-eating bat lived to the age of nineteen years in captivity.

FRUIT BATS

Family PTEROPIDAE

The fruit bats are found in the tropical regions of Africa, Southern Asia and Australia and include some of the world's largest species. In this group, the head is elongated and dog-like. The group shows certain primitive characteristics; for example, the claw on the second finger of the forelimb. Their eyes are larger than those of other bats, sight being in their case an important sense. Only one species in the group navigates by echo location.

During the day, fruit bats roost in leafy tree tops and many hundreds of them sometimes hang together, so that an inexperienced observer might pass them over as some kind of strange fruit, or growths. The diet of fruit bats consists almost entirely of vegetable food, mainly fruit, although some species sip the nectar from flowers.

Professor Eisentraut has described the roosting place of some fruit bats in Africa.

" . . . When we reached the sleeping quarters of the fruit bat colony, the noise was so great that we could not hear a word we were saying. Through my binoculars, I could now distinguish many bats moving about among the leaves in the tree tops. Some of the fruit bats were hanging head down from branches, swinging and flapping their wings, and turning their heads in all directions. Others were crawling about the branches apparently trying to find a suitable roosting place. This fruit bat colony was full of activity, which was certainly unusual with these nocturnal creatures. Perhaps it was because they had noticed our arrival.

"A great number of fruit bats were roosting here, but the cloud that rose up into the air at our shots surpassed all our expectations. The air was literally filled with flying fruit bats and their strident voices could be heard on all sides. Thousands circled about trees in which they had been sleeping a little while before. Some returned to the tree tops; here and there we could see mothers with young hanging on to their breasts as they flew."

Eisentraut further describes how males and females, grown young, and young just born, all lived together in the colony, which shows that the femals of this species are not isolated from the males when giving birth to young.

The most important representative of this group is the **Malayan Large Flying Fox,** which is about $15^{3}/_{4}$ inches long with a wing span of nearly 5 feet. Its head is brownish-black, its throat and abdomen rust-black. In some parts of the East Indian archipelago, the species forms gigantic colonies and causes great damage to orchards and gardens. Occasionally, however, they eat insects.

In some regions people hunt the fruit bat and consider it a delicacy. Europeans, on the other hand, consider roasted fruit bat obnoxious.

In Cyprus, which is the northern limit for fruit bats, the **Egyptian Fruit Bat** is found. This species is found all over Africa and in Asia Minor. A full grown Egyptian fruit bat has a wing span ranging from $2^{1}/_{2}$ feet to over 3 feet. It has soft, short fur, greyish-brown above and lighter below, with flanks of brownish-yellow.

All fruit bats do well in captivity as they are not difficult to feed. In zoos, they are not a great success as they spend the whole of the daylight hours hanging upside-down from the roof of their cage wrapped in their wing membranes.

Malayan Large Flying Fox

INSECT-EATING BATS

Most of the bats in this order are insectivorous. They differ from the fruit bats in the sharpness of their teeth. In certain species, the tail is free and the tail membrane only slightly developed. Most species, however, have the membrane attached to the tail so that it is drawn taut in flight.

This group presents many unsolved riddles of biology. In winter, all European bats fall into a deep sleep and it has been discovered that a temperature of 8—10° C. induces hibernation. To maintain hibernation, the temperature must not be too high or too low, and it has been found that the ideal level is between 3—8° C. Bats avoid places where the temperature is liable to sink below freezing point. Too high temperatures do not suit them either and a cave which holds thousands of bats in summer will not hold them in winter if the temperature stays at 10° C. or higher.

Nevertheless, bats are hardy enough to stand very low temperatures. Where the temperature goes down to 15° C. below freezing point, their body temperature will sink to 2° C. without harm. If, however, the temperature in a cave sinks so low that the bats will be in danger of freezing, their bodily functions quicken temporarily to force them awake and to seek a warmer roost. The Soviet zoologist, Kalabuchov, has shown that a young bat between the age of one and ten days old, and absolutely hairless, can stand a temperature of 7.45° C. below freezing point.

Instead of hibernating, some species of bats are migratory and move out from their summer quarters in the autumn. This was long suspected, and the older naturalists had frequently recorded that bats inhabiting high mountain ranges moved down to the valleys to hibernate in autumn. Modern investigation has since confirmed true migration, even if the migrations are not as spectacular as in birds.

Nowadays, bats are marked on a large scale. Aluminium rings are used but they are not fitted to the bat's leg; they are put round the elbow and are so light that the bat does not know they are there. The ring is stamped with the name of the Ringing Institute and the number. Ring marking has made it clear that bats can cover considerable distances in the autumn. A common pipistrelle, ringed in the Soviet Union, was caught in Bulgaria seventy days later. It had covered a distance of 715 miles. Another bat covered a distance of 1550 miles.

For many reasons, certain species of bats are becoming rarer in Europe. Old hollow trees are becoming fewer and fewer so that bats are losing their roosting places. Where artificial shelters are provided the bats hardly ever use them. Bats roosting in caves are also suffering, because great numbers of people visit the caves to see them and disturb them so much that they leave. The famous Domica Cave in Southern Slovakia, where thousands of bats of several species used to shelter, has now been deserted. This pinpoints one of the problems of the conservationist — that too many people can destroy the very thing they come to see.

The Microchiroptera sub-order of bats is divided into two groups according to the shape of their tails. In one group the tail is free, in the other the wing membrane is attached to it. In bats with a free tail, the tail either pierces the membrane and lies freely upon it, or projects beyond it. These bats have large upper incisors set close together.

The other group has upper incisors of normal size with a space between them. In some species, such as the spear-nosed bat, the tail is completely missing.

FALSE VAMPIRES
Family PHYLLOSTOMATIDAE

Vampire bats are a specialised group of free-tailed bats inhabiting only tropical South America. All vampire bats have a special growth on their faces, known as the nose-leaf. They may be found living singly or in colonies in trees, abandoned buildings and caves. Formerly it was widely believed that all vampire bats were blood-suckers, but it has now been discovered that most of them are absolutely harmless. Many are insectivorous and some are even vegetarians, preferring fruit to anything else. Only a few species, the true blood-suckers, feed on blood.

Foremost among these is the **Spear-nosed Bat,** which is about 4 inches long. It is found in Brazil. During the day it hides in tree hollows under wide palm leaves.

Even to-day we still do not know if the spear-nosed bat really sucks the blood of other animals. Bates described an episode in which he attributed his thigh wound to a spear-nosed bat. But Lyddaker doubts this and suggests that the wound was probably caused by another species of bat. At the same time, Wallace considers the spear-nose a blood-sucker. In more recent literature, Eisentraut describes the spear-nosed bat as rapacious but does not mention that it sucks blood. He tells of one breeder of bats who put seven spear-noses and twenty-seven smaller species in the same cage. The next day only one of the smaller bats was still alive; the twenty-six had been killed and eaten by their bigger relatives. Other spear-nosed bats kept in captivity killed every mouse, bird or bat that was let into their cage. An indication of the rapacity of these bats is given by their teeth. They consume great quantities of food and one spear-nose has been recorded eating three mice in one night.

It has not so far been possible to determine exactly what the spear-nose hunts and what it feeds on. We know only that it will hunt birds and that birds' feathers have often been found below its roosting place.

The largest bat of the vampire family is the **False Vampire,** which is found in Central America, Jamaica, Brazil and Guiana. Its body is nearly $6^1/_2$ inches long and it has a wing span of $2^1/_4$ feet. Bates describes it as follows:

"Nothing can be uglier than the face of this bat. Its large auricles sticking out, the upright growth on its nose, and the black, scintillating eyes, together form a whole which reminds one of a fairytale goblin. It is not surprising that human fantasy attributes demoniacal qualities to

False Vampire Bats

this creature. Nevertheless, this is one of the most innocent bats in the world and its harmlessness is known to all those who live along the banks of the Amazon."

All the terrible stories about how this bat sucks the blood of other animals are sheer inventions, for this harmless creature feeds on insects. In the stomachs of dead vampires the remains of seeds and fruits have been found. So we see that neither the spear-nose nor the false vampire is in any way dangerous.

TRUE VAMPIRES
Family DESMODONTIDAE

The **True Vampire,** or **Blood-sucking Bat,** is about $2\frac{3}{4}$ inches long and is found in Mexico, Paraguay and Northern Chile.

Its whole digestion is adapted to the special food it takes. Its stomach is not pouch-like as in insectivorous bats, but is a kind of thin-walled tube which can expand to hold large quantities of blood.

The true vampire has only twenty teeth, but its upper incisors are very large and as sharp as a knife. The long, narrow, canine teeth have a sharp point with a cutting facet. The molars are simple and stunted because the bat does not need them.

This bat uses its front teeth like knives. With them it can quickly cut the skin to a depth of one-eighth of an inch. When the blood begins to flow the bat licks it. It does not suck. The main victims of the true vampire are sleeping cattle which are attacked during the night, but the bat will even attack a sleeping man. Although the wound made by the bat will bleed for a long time it has never been known to be fatal.

The actual damage done to cattle by bleeding is not serious, but where true vampires are plentiful they keep the animals on the move throughout the night, with the result that they grow weak and lose weight. Another side effect is that the open wounds attract various insects which lay their eggs in them. With smaller domestic stock such as fowls, the bite of the vampire is much more serious, for the birds can really die from loss of blood.

The true vampire can so gorge itself with blood that it begins to look like a ball. This state has been induced in captive vampires by feeding them to capacity. One bat fed on the blood of a domestic goat for a full ten minutes and so gorged itself that it could not fly. According to Eisentraut, it looked more like a bloated sheep tick than a flying mammal.

In the second group of bats, we have those whose tail is joined to the wing membrane.

HORSESHOE BATS
Family RHINOLOPHIDAE

The Horseshoe bats are recognisable by the horseshoe-like growth on the nose. All are found only in the Old World, Europe, Asia and Africa.

The **Greater Horseshoe Bat** is the largest of the horseshoes. The nose-leaf is highly developed and resembles a horseshoe. There is no tragus. The pointed ears are longer than they are broad. The wing span is one foot or more and the females are larger than the males. The general colour of this bat is greyish-brown above and buff below. Young animals are greyer than adults and males are greyer than females.

The greater horseshoe bat emerges from its roost an hour or so after sunset and hunts along woods, hedgerows, banks and fences; usually it is a few feet off the ground but sometimes at hedge height. It preys upon moths, beetles and spiders. It devours small prey on the wing but carries larger insects to a resting place where it dismembers and eats them. Some prey, the dor-beetle for example, is captured on the ground.

A single young is born in late June or early July. The female greater horseshoe carries her young around with her for some time until it is about half her own weight, then she leaves it hanging at roost while she hunts. Young are on the wing by the middle of August and they are as big as adults before they go into hibernation. Females do not breed until their second or even their third autumn, in October. In April the female ovulates and is fertilised by stored sperms.

Tawny and Barn owls prey on the greater horseshoe bat and both have been recorded roosting where the bats are hibernating. Their predation can be heavy.

The **Mediterranean Horseshoe Bat** is found all over Southern Europe, Asia Minor and North Africa. It lives mainly in caves.

Greater Horseshoe Bat
Lesser Horseshoe Bat

The **Lesser Horseshoe Bat** is the smallest of the horseshoes, its wing span being from $8^1/_2$ to 10 inches. Otherwise, it is very similar to the greater horseshoe in general colour and appearance.

Greater and lesser horseshoe bats frequent much the same kind of habitat. The lesser horseshoe hibernates in caves, in mine galleries and in cellars, and in summer can be found roosting in attics and buildings during the day. It will sometimes roost in trees during hot summer weather, but will never hibernate in them.

The lesser horseshoe hibernates from October to March or April, but it is often active in its hibernation quarters for some time after it retires, and again in spring for some time before it emerges. During

Lesser Horseshoe Bat

the day it is a light sleeper and there is sometimes a great deal of quarrelling in the colonies. When the bats hibernate in damp places, drops of water often gather on their membranes, giving the whole colony a silvery appearance when a lantern shines upon them.

The prey of the lesser horseshoe is much the same as that of the greater horseshoe. This species emerges later than its bigger relative and its flight is quite different. Its wing stroke is very fast, too fast to be seen by the human eye and it flies erratically, frequently changing height. It will hunt from within a few feet of the ground up to about fifteen feet.

The lesser horseshoe bat has a single young, born in late June or July.

Family VESPERTILIONIDAE

In this group there is a nose-leaf, but no tragus. Their molar teeth have sharp points shaped like the letter W. This family of bats is spread over most of the world, except very cold regions, and comprises about two hundred and seventy species.

The **Parti-coloured Bat** is in the medium size range; its forearm measuring from $1\frac{1}{2}$ to $1\frac{5}{8}$ inches, and its wing span from $10\frac{1}{4}$ to $11\frac{1}{4}$ inches. The fur on its back is light brown and brownish-black tipped with white, which gives it a silvery appearance. The under parts vary from greyish-yellow to brownish-yellow. The female has two pairs of nipples.

This species is found all over Europe and across Siberia to Kashmir, Mongolia and Japan. It hibernates in caves and perhaps also in hollow trees. During the summer months it roosts in rock clefts, tree hollows and in attics.

The **Common Pipistrelle** is a very small bat. Its forearm measures from $1\frac{1}{8}$ to $1\frac{1}{4}$ inches and its wing span is $7\frac{3}{4}$ inches. Its body is about the size of a pygmy shrew. The sexes are about the same size and the usual colour is some shade of brown. The ears are wide-set and their length exceeds their breadth. There is a tragus but no nose-leaf.

The pipistrelle is found over the whole of temperate Europe and much of Asia. It is common in towns and villages as well as the countryside and can be found in buildings, trees and rock clefts. During hibernation it will roost in caves, houses, towers, in lofts and behind shutters and will squeeze into corners seemingly too small for it. In summer it will roost almost anywhere. In summer as well as during hibernation, the pipistrelle is gregarious and great numbers can often be found together. It mixes readily with other species.

On the wing, the pipistrelle is talkative where many are flying at the same time. They can make about as much noise as swallows. Almost all prey is taken on the wing and many types of insect are caught, but gnats appear to be the main prey. Small insects are eaten on the wing but bigger ones are often taken to a resting place to be dismembered. Large insects may also be pouched at times in the interfemoral membrane to be eaten later.

Pipistrelle mates in the autumn and early winter and in the following May the female ovulates. Fertilisation is by stored sperms. The gestation period is

orty days or longer and a single young is born in the latter part of June or the first half of July.

Although a hunting pipistrelle may be away from its daytime roost for the whole night, it does not spend the whole night on the wing but rests in a variety of places, returning to its day roost before sunrise. In mid-summer the usual time of emergence is sunset, but in spring and autumn it may be later. It is not inhibited by bright moonlight. During its hunting the pipistrelle flies erratically up and down and criss-crossing. It will hop hedges and walls like a sparrowhawk.

The flying season is from March to October, but the pipistrelle may be seen any month of the year and can be seen even in mid-winter on a sunny afternoon when the ground is covered with snow.

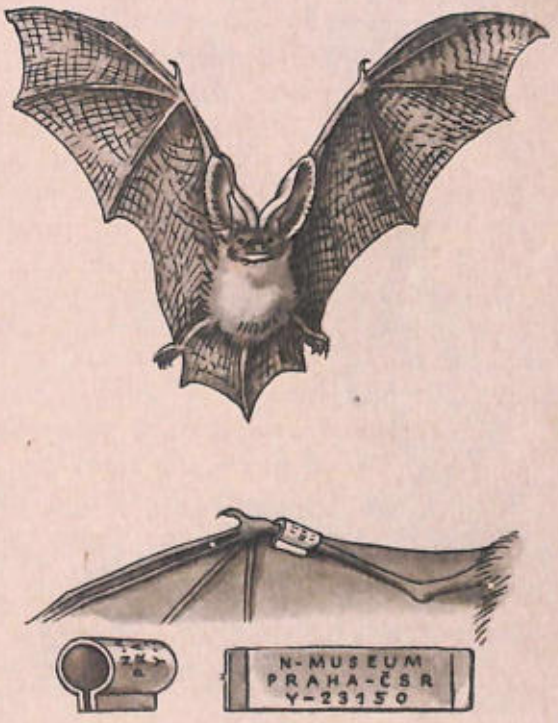
The **Noctule Bat** is found over most of Europe and eastwards through Asia to Japan. It is also found in Burma and Malaya, is common in England and Wales and has been recorded from Scotland as far north as Morayshire. It is found mostly in wooded and forest areas and frequents buildings and trees. It hibernates in buildings and cellars but only rarely in caves or in rock clefts.

The wing span of the noctule is 13 to 14 inches and females are larger than males. The upper fur is long and silky and golden brown in colour; the under side is duller and paler. Males are glossier than females, and young animals darker than adults. Melanism has been recorded. The ears of the noctule are wide-set and broader than they are long. The tragus is broad and short; and the tail projects slightly beyond the interfemoral membrane. The head is strikingly large and the face resembles a bulldog's. The noctule has an unpleasant odour which comes from the glands in its mouth.

In Britain a single young is the rule, born in June or July, but twins are not uncommon in Europe. At roost there is some segregation of the sexes, especially when the females have their young.

The hunting noctule might well be compared with a falcon, for it flies high and fast in straight flight or in wide turns, then will stoop from 80 to 20 feet. It has been reckoned that the noctule is almost as fast in flight as the swift. The main food is beetles, but moths and gnats are also taken and all prey is captured and eaten on the wing.

Although the noctule is active on and off during the night, it has two main hunting periods; the evening flight before and after sunset and the morning flight before



Ringing Bats for identification

sunrise. It is a noisy bat; on the wing it squeaks shrilly; when excited, or alarmed, it screeches.

Hibernation begins in October and ends in March or April. This is a gregarious species and colonies up to three hundred have been recorded.

Ringing has shown that this bat can fly great distances and Formosov believes it is regularly migratory and this opinion is confirmed by numerous observations of mass migrations during fine weather. On the other hand, ringing has not so far shown any proof of distant migrations; but one bat ringed on 21st August, 1949, in Riga, Latvia, was shot on 25th September of the same year in Czechoslovakia. It had covered a distance of over 570 miles.

The **Lesser Noctule,** or **Hairy-armed Bat,** is a much rarer species, extremely local in distribution. Like the common noctule, it is often migratory.

Long-eared Bat

The **Serotine** is found throughout Europe and Asia and in Algeria and Tunisia. Its wing span is from 13 to 15 inches and the wings are relatively broad. The fur of the back is long and dark-brown, sometimes with a chestnut flush. The oval ears are longer than they are broad. The tragus, which is very long, is rounded at the tip with a curved hind edge. The tail projects for $^{3}/_{16}$ to $^{5}/_{16}$ of an inch beyond the interfemoral membrane.

This species is very rarely found hibernating in caves, and in fact is closely associated with human habitation, frequenting buildings and hollow trees. It hibernates in the roofs of buildings, whether houses, churches or barns, and apparently also in hollow trees.

The serotine lives in small colonies of twenty to fifty, very often in the roofs of houses. The bats emerge soon after sunset and are active on and off throughout the night. Although usually silent in flight, they can emit high-pitched squeaks, especially when a number of them are flying together. The flight is slow and hesitating but the serotine is capable of bursts of speed and can swoop like a falcon. The main prey appears to be beetles and moths.

Hibernation is from October to early April and a single young is born at the end of May.

The **Long-eared Bat** is found over much of Europe, from England and France eastwards and north to Finland and Sweden. Its distribution eastwards and southwards is not accurately known but it has been recorded in Austria and Northern Italy. It is numerous in Czechoslovakia.

This species can be recognised at once by its unusually big ears, which are almost as long as the head and the body together.

When the bat is resting it folds the ears under its wings, leaving the tragus erect. When the bat is awake, or alerted, it will partly unfold its ears so that they curve up like a ram's horns. Its hearing is good and it almost certainly uses its ears when hunting prey on the ground.

The wing span of the long-eared bat is about 10 inches. The sexes are alike in colour, the upper fur being brown and the underfur yellowish-brown, or yellowish-white. The fur is long and silky and very dense on the shoulders.

In summer, the long-eared bat sleeps in buildings and trees. It is closely associated with human habitation and has often been recorded flying through open windows to hunt flies in a room. It thrives in captivity if properly cared for and soon becomes tame.

The main food of this species is moths and butterflies, especially butterflies of the tortoiseshell and peacock family, but beetles and a great variety of other insects are also taken. Most prey is captured on tree trunks and foliage, but some insects are caught and eaten in flight. Large prey is pouched and carried to a resting place to be dismembered and eaten. Hunting usually begins from half-an-hour to an hour after sunset, depending on the time of year and the weather. The bats hunt on and off during the night and in good weather there will always be some of them on the wing, squeaking as they hunt. The flight is moth-like with occasional glides. The long-eared is also agile on walls and roofs where it will hunt moths and spiders. During its hunting, the bat will alight at regular intervals to drink. It also alights frequently to dismember large prey, the remains of which can be seen at such stripping places.

There are two mating periods in this species, in the autumn and spring. Mature animals mate in the autumn but the second mating is apparently of animals too young to breed then.

Long-eared bats often hang out in trees during the summer or early autumn but they move into houses or hollow trees as the weather grows colder. Hibernation is from October to March. Animals sleep singly or in small groups, but awaken readily and often fly on mild winter days. In late summer, they sometimes assemble in large numbers and there is some evidence of migratory movements.

The **Long-eared Austrian Bat** closely resembles the foregoing species. The Austrian long-eared bat is generally darker in colour. The bat is always grey without any brown or yellow as is usual in the long-eared bat. In addition, the Austrian long-eared is slightly larger but the main differentiating characteristics are in the skull. Unlike other bats that have small eyes almost hidden by their fur, both long-eared species have large eyes with which they are able to see quite well.

The **Mouse-eared Bat** has a wing span of $15^1/_2$ inches. It inhabits all Central Europe and a great part of Eastern Europe and has been recorded from time to time in Southern England as a vagrant.

This bat is found mostly in lowland country up to a height of about 2,000 feet. Summer colonies are found in attics and towers, cellars and caves, and may number up to thousands of animals. During this period there is segregation of the sexes, the females forming separate groups while rearing their young. In winter, however, males and females hibernate together in caves. tunnels and cellars and these roosts, like the summer ones, may

Mouse-eared Bat

number up to thousands of animals in tightly-packed groups. Below the roosts the faeces of the bats build up into great heaps and in some places are gathered as valuable manure.

When handled, the mouse-eared bat is bad-tempered and will bite. Once it takes hold of a man's finger it is reluctant to let go and can cause a considerable wound.

The summer and winter roosting places of the large mouse-eared bat are often in places far apart. The Soviet zoologist, Kuzjakin, has shown that most large mouse-eared bats will fly for a distance of 18 to 21 miles from their wintering place. But many fly much farther than this and ringed bats have been recorded from 110 to over 150 miles. Yearly examination of winter quarters has made it clear that colonies return to the same winter quarters year after year. One ringed mouse-eared bat was taken over 90 miles away from its roost and released but returned home almost at once. Much work has been done in the ringing of mouse-eared bats in Czechoslovakia, and between 1949 and 1960, 6,000 were flying wearing the rings of the National Museum.

The **Lesser Mouse-eared Bat** inhabits the southern parts of Eastern Europe and Central and Southern Asia. It is similar in appearance to the large mouse-eared bat and is only a little smaller.

Bechstein's Bat has a wing span of 10 inches. It is brown above and dirty-white below. It has very long ears which are not joined at the base. In summer the species frequents holes in trees but during hibernation is often found in caves. Its main food is probably moths. In Europe a single young born in June is the rule. Bechstein's is the rarest British bat.

The **Pond Bat** is a rare European species which lives in attics and hollows in trees, always close to water.

Daubenton's Bat, also known as the **Water Bat,** is found in most parts of Europe and in many parts of Asia, east to Japan. It is numerous in many counties of England, North Wales and Scotland. It has a wing span of $8^1/_2$ to 10 inches and the upper fur is warm brown in colour; the base of the ears being darker than the tips. The under parts are greyish-white, sometimes with a yellow tinge. The ears are longer than they are broad and set widely apart.

This is the true water bat. It hunts all its prey over water and is the species most usually caught on the fisherman's fly. In summer it roosts in buildings, caves, hollow trees and rock clefts. During hibernation, it sleeps in caves and buildings, never in trees.

The food of Daubenton's bat is almost entirely of aquatic insects which are caught in flight and eaten on the wing. Larger prey is pouched. On warm summer nights many of these bats are some-

times to be seen hunting together low over the water and lightly breaking the surface at intervals. They are deceptively fast flyers and hunt in circles with flickering wings.

The **Whiskered Bat** derives its name from the long fur growing round its mouth. It is found over most of Europe and Asia and is common in most parts of Britain. The sexes are alike in colour and size and the silky upper fur is dark brown and the underside greyish-white in adults, darker in young animals. The tragus is half the length of the ear. The wing span varies from 8 to 9 inches.

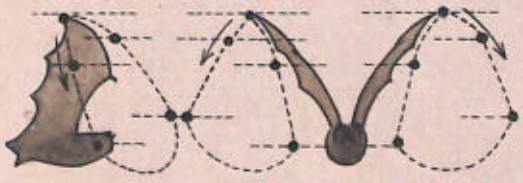
The whiskered bat frequents buildings and trees in summer. It hibernates in caves, cellars and in holes in rocks, but not in trees. Its food consists of flies and spiders and although some prey is taken on the wing, most is picked from foliage, posts and fences.

In the summer months, outside the breeding season, the whiskered bat is not sociable and usually roosts alone. It hibernates from October to March, usually singly, but sometimes in small colonies. A single young is born in June or July.

In flight, the whiskered bat much resembles the pipistrelle. It hunts a beat but does not fly high and is not talkative on the wing.

Natterer's Bat is found throughout most of Europe and Asia and east to Japan. It is fairly common in most parts of England and Wales and is recorded from time to time in the southern half of Scotland. It frequents woodland and timbered parks, usually in the vicinity of water.

The usual colour is greyish-brown above and white below, but there is much variation. From the base of the ear to the shoulder there is a clear line of demarcation between the colour zones. The ears are wide-set, longer than they are broad, and the tragus is more than half their length. The wing span is from $10^1/_4$ to 11 inches. The food of Natterer's bat is mainly insects and spiders. Some insects are taken on the wing and some picked



Skull of Bat. Flight of Bat

Barbastelle

from leaves, posts and walls. The flight is slow and low, from a few feet to about 15 feet above the ground. The bat squeaks while it hunts and flies at intervals throughout the night, from early evening until close on sunrise.

Natterer's bat hibernates in caves or buildings from September to March but will make short flights on mild nights during the winter. Although gregarious, in summer it is often found singly during hibernation.

Noctule

The **Barbastelle** is found in most of Europe and into Western Asia, but is not really plentiful anywhere. In the British Isles it is confined to England and Wales. It is a bat of forested areas and woodland. In summer it frequents buildings, caves and trees, but hibernates only in caves, and according to Eisentraut it never uses damp caves where water drips from the ceiling; instead it seeks dry places which other species tend to avoid.

Colonies numbering several thousands are found in winter in the caves of Eastern Slovakia.

The fur of barbastelle is dark-brown, almost black, and the bat looks black in flight. The sexes are alike. The upper fur is long and silky and overlaps on to the wing and interfemoral membrane. The ears, which are short and broad, are set close together almost touching each other. The wing span is between 9 and 10 inches. The main food of barbastelle is moths, flies and gnats caught and eaten in flight. The bat emerges earlier than most other species and sometimes in good light. There is also a morning flight before sunrise and between the two there is a long resting period. The barbastelle is a slow flier and hunts under 20 feet from the ground.

A single young is born in late June or early July. Hibernation lasts from October until April or even May, but the barbastelle will come out on good days in midwinter.

Schreiber's Bat, or the long-winged bat belongs to the special sub-family Miniopterinae. It has a strikingly low forehead

and short ears set widely apart and hidden in the fur. Its wings are narrow, long and pointed. This species is found throughout Southern Europe, the Middle East and the Far East to Northern Australia.

Schreiber's bat is entirely a cave dweller and shelters in caves both in winter and summer, in colonies up to several thousand in numbers.

Kuzjakin has written of this bat as follows: ". . . On the Black Sea shores of the Caucasus is the main habitat of the long-winged bats. In the Bachardensky Cave the air is permanently saturated with vapours from the large underground lake and in these dark, underground places, the long-winged bats assemble in enormous numbers. In 1947, I estimated that there were 40,000 bats assembled there."

Some colonies are made up entirely of long-winged bats, but others are mixed.

Kuzjakin noted how long it took 40,000 long-winged bats to clear the cave in which they were roosting. The time was 75 minutes from the first bat to the last. On the peak of emergence between 9,000 and 12,000 were leaving the cave in ten minutes. From this observation it is evident that the long-winged bats leave their day roost *en masse* in a gigantic cloud. As their name indicates, the long-winged bats are wonderful fliers. Satunin writes that

Schreiber's Bat

". . . as far as the speed of their flight is concerned the long-winged bats have no competitors among Vespertilionidae."

So far it has not yet been possible to discover whether the long-winged bats remain in the same roost summer and winter. But in some parts of Europe, some bats certainly do, although certain migratory flights have been noted. This has been established in Czechoslovakia. In the caves of Southern France, this same variation in behaviour has been noted. While some abandoned their summer shelters, others remained. In some years all the bats remain in the same roost summer and winter, while in other years they fly away *en masse*. This variation in behaviour may be caused by climatic conditions.

Recently the numbers of the long-winged bats in the caves of Southern Slovakia have been dwindling and it has been suggested that caves which are permanently occupied should be established as sanctuaries and the public excluded.

ORDER: PRIMATES

Most of the species in this large Order live in trees and all of them have five-toed feet. Almost all of them have flat nails on their fingers and toes, just like human beings. The name Primates means First or Highest, and indicates the high degree of development of the Order, to the last family of which Man belongs.

The Primates are notable for the great development of the brain. Even in less developed species of the Order, we find a greatly developed brain which is the centre of all higher nervous activity. In man, it is the centre of all thought and spiritual awareness. It has been shown that the development of the brain is far more important in evolution as a whole than the development of any other organ. A convincing proof of this is the impressive human brain.

The limbs of the Primates have proved that they can be used as excellent tools. Basically, the limbs of the Primates are designed to climb trees. It is for this reason that the thumb can be placed opposite the other fingers. But, later, the limb became a versatile tool as, for example, the human hand.

The eyes of the Primates are perfect. They look in front and give spatial sight. This means that with the help of a perfect brain the eyes of the Primates obtain a highly precise picture of the outside world.

Primates have few young and these young are born with open eyes. They are, however, dependent for a long time on their mother's care. All Primates have milk teeth, followed by permanent teeth.

Of all the Primates, the Prosimii or semi-apes, are the most closely related to their insectivorous ancestors. More than fifty species of semi-apes still exist and of these forty are found in the island of Madagascar, where they are the most numerous mammals. The remaining species inhabit the jungles of Africa, India and Malaya.

Prosimians are tree animals and all are excellent climbers. Although most of them are small, they have great strength in their limbs and are able to hang on by one limb for long periods of time without any sign of fatigue. In this they resemble the sloths whose blood circulation is adapted to this way of life. Usually if a muscle is strained for a long time the tension leads to cramp, because the part cannot be supplied with enough blood. In the case of the sloths and the semi-apes the arteries form a dense network in every muscle, ensuring a rich blood supply and plenty of oxygen, no matter how long the muscle is strained in any position.

The dentition of the semi-apes is a further indication of the relationship. There is a gap between right and left upper incisors as in the insectivores, bats and maruspials. The canines in the lower jaw are similar to the incisors and closely attached to them. Viewed from the front, these teeth resemble a comb and the semi-apes actually use them for combing their thick fur. Another characteristic of the semi-apes is their so-called under tongue, which is a kind of second tongue like a fold under the tongue proper and is developed even in the marsupials. In man and in the anthropoids, there remains only a small fold joining the under part of the tongue to the mouth cavity. This can be seen merely by lifting the tongue and examining the underside in the mirror.

Some of the females in this group actually have a fold of skin on their abdomen similar to the marsupial pouch, except that it is not supported by bones and the mother never places her young in it. She holds the young one across her abdomen. Some semi-apes carry their young in their mouths.

The brain of the semi-apes is not so highly developed as that of apes, but when compared with that of other mammals it is proportionately larger. Being nocturnal, the semi-apes have eyes well adapted to seeing at night. They also have an excellent sense of smell.

TREE SHREWS
Family TUPAIIDAE

In size and appearance, the Tupaias closely resemble squirrels and were in fact first described as squirrel-like rodents. This is understandable because they have a long slender body and a long, bushy tail and all are excellent climbers, moving about with great skill in trees and bushes. Their dentition, however, closely resembles that of the insectivores, the teeth numbering from thirty-eight to forty, while their hairless ears resemble the ears of monkeys. For a long time, the tupaias were placed by zoologists along with the insectivores, but recent investigations, including study of the living animal as well as detailed dissections of its body, has enabled zoologists to classify them as semi-apes.

Nowadays, tupaias are important to zoologists because they are the intermediate forms which bridge the gap between the insectivores and the Primates. The tupaias provide a clear warning against judging animals merely by their outer appearance or by certain colours or shapes. Thus, a "squirrel-like rodent" turns out to be a Primate.

There are about twenty species of these small semi-apes still living in Southern Asia, from India to the Philippines, and from Central China to Java and Borneo. Their preferred habitat is damp and bushy regions.

The largest of the tupaias, **Tana Tana** measures about 16 inches from nose tip to tail tip, including a tail of nearly 8 inches, and is found mainly on Borneo and Sumatra and on some South-Sea islands.

The most numerous and widespread species, however, is the **Common Tree Shrew** and this is the one most often kept in captivity. It is found in India, Hainan, also the Himalayas, Southern China and on the islands of Sumatra, Borneo and Java. As its name indicates, the common tree shrew is an arboreal species. It is active by day and spends the night sleeping in hollow trees, or on the ground.

Most of what is known about tupaias has been learned from captive animals which can be observed daily under control. Like many other species of animals, tupaias were once difficult to breed in captivity, but scientific methods have now got around this difficulty and it is now possible to breed and rear them. Standard practice is to give them a large cage with plenty of branches for climbing in, and a nesting box in which they can sleep at night. With the coming of daylight, the

tupaias awake, stretch, yawn and clean their fur. They use their lower incisors to comb their body hair, giving special attention to their bushy tails.

The main food of the tupaias consists of insects, grubs, fly larvae, ant larvae and cockroaches. They will also eat the flesh of birds or fish. Besides animal food, they are fond of salads, sweet fruits, grated carrots, egg and biscuits. They drink milk, sweet syrups and tea. After feeding, the tupaias become very active in their cages, climbing dexterously about in the branches. They are as active and mobile as stoats at play and their energy is extraordinary. Round about the middle of the day they roost for a period of two hours or so, dozing or lying wide-eyed on a high branch. The resting period is followed by a further spell of feeding and activity. In the evening they retire to their sleeping box and sleep throughout the night.

They will not tolerate any lining in their sleeping quarters and if any material is placed therein, they immediately carry it out. They keep their sleeping quarters scrupulously clean. So long as there is light the tupaia will lie in its box, looking out of the entrance hole. Only when it is quite dark will it curl up and fall asleep. The animal uses its bushy tail as a mattress and actually lies on it. The tip of the tail is then curled over the head. It is a profound sleeper and can be picked up in the hand without being awakened. This habit is helpful if an animal escapes from its cage, because it can be picked up easily after it has fallen asleep. Tupaias indeed are born escapers and if there is a loose wire or a door, they will find it and claw their way out; hence the almost daily escapes in the early days. When a tupaia escapes for the first time it is easily caught because it will come to the hand to be fed, but after being recaptured several times it becomes wary. Live-catcher traps, baited with meal-worms, were then used. When the tupaia went inside, the door slammed behind it, but the animals quickly saw through this method and refused to enter the box, no matter what bait was used. Catching them with a net proved to be well nigh impossible. They can move about so quickly, even in a confined room, that they cannot be caught by hand. Five people who once took part in such a chase kept catching each other, while the tupaias adroitly leaped about the hunters' heads and backs as the chase went on. They can slip through very narrow spaces and just when you think you have cornered one behind a piece of furniture, it is looking down on you from the ceiling lamp, or the top of a window.

Almost all tupaias seek a hiding place in burrows, or other dark holes in the ground, and on one occasion, after an unsuccessful indoors hunt, the zoologists left a coat hanging from a window and waited for darkness. The tupaia was found sleeping in one of the sleeves and was easily caught up. This would appear to indicate that, in the wild state, tupaias escape from danger by hiding in holes in the ground. It was found that a rubber thigh boot lying on the ground would be used if no other shelter was available. The voice of the tupaia is a penetrating rhythmic bark, emitted with the mouth closed. During the breeding season, the male makes a sound like the grinding together of two pieces of flint. Fighting males utter sharp, barking, threatening cries. Besides this, five other calls have been described, when an animal is curious or discontented, or during the submissive posture of a female towards a male. One characteristic sound is the smacking of the lips during feeding.

The tupaias hunt by sight and smell, and turn over the ground litter with their noses in search of prey. They can catch insects on the wing with a swift movement of the paw, and when fishing they can hook out water-snails, newts, or small fish. When feeding, the tupaia holds its food in its forepaws, after the manner of the squirrel, but the paws are much more truly hands as closer examination reveals. If food is offered to a captive tupaia, it takes it in the paw like a hand. In the same way, they will use their paws to take food from a plate and place it in their mouths. When feeding, the tupaia's lower jaw moves sideways as well as up and down.

Tupaias set scent on their hunting territory, especially the males which have specially developed cutaneous scent glands on their throat and breast. The secretion from these is rubbed on to branches and stones and in the case of captive specimens all over their cage, including their sleeping hut. The odour is powerful enough to be detected by the human nose. Tame tupaias will rub the secretion on to the hands of their keeper. Male tupaias also mark their territory with their urine; a habit noted in other semi-apes like the loris. They will sprinkle drops of urine over branches as they run about in them. They also urinate on their paws. In time, all these marked places acquire a glassy surface, caused by the mixture of urine and the secretion from the throat glands. If this surface is removed, the animals will renew it again and again, and for this reason captive tupaias prefer their cages not to be cleaned.

Tana Tana

Tupaias breed several times a year and eight families have been recorded in captivity. The female prepares her breeding nest with great care, lining it with grass and leaves. The gestation period is forty-three to forty-six days and litter size numbers one to three. At birth, small tupaias are completely hairless and blind. The eyes open on the nineteenth or twentieth day and the young leave the nest in something under four weeks.

LEMURS

Family LEMURIDAE

The name Lemur comes from the Latin, *Lemuris*, which to the ancient Romans meant the evil spirits of the dead. To propitiate these evil spirits, the Romans held a festival at the beginning of May, the so-called Lemuria. The Romans believed that the lemurias lived in the fire places and looked out of the flames at people. This roughly explains the name given to the quaint semi-apes of Madagascar. Their nocturnal habits, lamenting voices and certainly their luminous yellow-red eyes, reminded their discoverers of this ancient Roman superstition.

In the context of evolution, the lemurs are a very ancient group of animals which still exist today only because the island of Madagascar became separated from the African Continent of which it was once a part. Formerly, the group was far more widely distributed, but the species died out everywhere else because they could not compete with other mammals. The existing lemurs are, of course, only a small remnant of what had once been a great and widely distributed group. Even on Madagascar we find the remains of species that have become extinct there. The largest lemur that ever existed was the Giant Maki, which grew to the size of a donkey. Compared with it, all the present-day lemurs are dwarfs.

The limbs of lemurs and other semi-apes are highly adapted to their way of life. As soon as a lemur bends its elbow or knee a special tendon automatically curves its toe. The animal can, therefore, fall asleep wherever it happens to be crouching, because the locked tendon will keep the claws grasping the branch so that it cannot fall. A similar arrangement is found in birds.

A typical representative of the semi-apes of Madagascar is the **Ruffed Lemur,** a handsome black and white animal with fine whiskers. It is the largest of the true lemurs, measuring, when full-grown, 4 feet in length including the long tail of about 2 feet.

The ruffed lemur lives in high forest with thick undergrowth which is difficult to penetrate. During the day it sleeps in a hollow tree, curled up into a ball. At dusk it comes out to hunt. Among the branches it moves slowly but surely. Its main food consists of sweet fruits and it is very fond of bananas. But when it comes across a beetle or a grasshopper, it will pounce upon it and seize it at once. It has also been recorded eating small birds and birds' eggs and, occasionally, small mammals.

The ruffed lemur was once common but is now in danger of extinction.

The **Ring-tailed Lemur** is a gregarious, diurnal species with a long and foxy face. It is an active, quick-moving animal, with a long black and white tail. It is smaller than the ruffed lemur, reaching at most an overall length of three feet. Body colour ranges from grey to rust. The black, bushy tail is ringed with white.

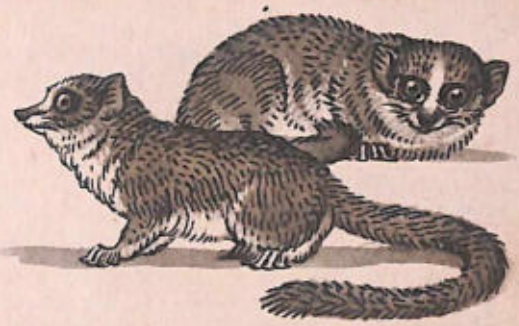
This species is not strictly arboreal and is found largely among rocks in South Madagascar. Social life is highly developed in this species and much social grooming takes place, the animals parting and cleaning each other's fur. The communal habit is also notable in the breeding season when groups of young may be cared for by females other than their mothers. The number of young at a birth is usually two, but sometimes one and three have been recorded in captivity. The gestation period is about five months. For the first three weeks after birth, the young cling to the underside of their mother's body, but after three weeks of age, they travel on her back.

Because of the beauty of their fur and their elegant movements, ring-tailed lemurs are often kept in captivity. Young animals tame readily and soon follow their keeper, or owner, about like a dog. Unlike monkeys, they are clean in their personal habits and not nearly so mischievous when kept as pets. An objection to the ring-tailed lemur as a pet is that, like all other semi-apes, it has a distinctive

smell. There are black scent glands on the wrists and the secretion from these is spread all over the fur and tail when the animal grooms itself several times each day. When alarmed, the animal passes its tail readily between its wrists, thus spreading the secretion from the scent glands along its entire length. Although this species, like all the others, has nails, there is a claw on the second toe which is used for scratching. In conjunction with the lower front teeth it is also used for grooming the fur.

The **Lesser Mouse Lemur** is the smallest species of the group and the smallest living Primate, being little bigger than a big mouse. The body measures about $4^3/_4$ inches and the tail nearly 6 inches. This species has very thick and extremely fine fur, with hairs which are black at the root. On the back, these hairs are tipped with red and on the abdomen with white. The general appearance is squirrel-like. The eyes are large and close-set and the membraneous ears prominent. On both sides of the body, between the knee and the elbow, is a skin fold with air sacs which extend on to the back and head and it is possible that these air sacs become inflated when the animal is gliding.

The lesser mouse lemur inhabits thickets in both dry and swampy places. It likes to sleep in hollow trees during the day but will also make a nest in the open. It feeds almost entirely on insects which it catches mainly by leaping. Occasionally, it will eat leaves and fruits.



Lesser Mouse Lemur

During the dry season, the lesser mouse lemur falls into a deep sleep. This summer sleep is known as aestivation and during it the animal lives on stored fat. This fat is stored during the wet season when food is plentiful, and is located mainly at the root of the tail. Specimens captured with a full deposit of fat were once thought to belong to a different species.

In the breeding season the female builds a special nest for her young. This nest resembles a bird's nest and in it two or three young are born at the beginning of the wet season.

INDRISES

Family INDRIIDAE

Unlike the lemurs, which have long bushy tails, the members of this family have stunted ones. The largest species in this group stands about 3 feet tall and has a tail stub of one inch or more in length. The limbs are long, the hind legs especially so, and the palms of the hands and feet large. The thumbs of hind and forefeet are very long.

Although the **Indris** is strikingly humanoid, the face is dog-like and hairless. The body is covered with long, woolly hair, which can be black, ash-grey, or white.

Indris

Unlike other semi-apes, the indris has small eyes and its ears are almost hidden in its fur. It is diurnal but not much more is known about its habits because it lives in such isolated localities in the mountainous forests of Eastern Madagascar.

The name "indris" arose because of a misunderstanding. When the natives pointed to the indris, calling *indrizi* the discoverers assumed they were naming the animal — whereas they were merely drawing attention to it by calling out "Look!", or "There it is!". The natives actually called it babakoto, or ambalana. The animal was considered sacred by some tribes; others would not hunt it because it was credited with the power of catching their spears and hurling them back with unerring aim. Many legends surround the indris, which the original inhabitants of Madagascar revered as a holy animal. It is a confirmed sunbather and so was looked upon as a sun worshipper because of its habit of exposing its body and holding its arms towards the sun. It has long been believed that the natives can train the indris to hunt for them like a dog.

The indris is a social animal, living singly or in packs, and is diurnal. It is mainly a leaf-eater, but it also takes a variety of fruits, some insects and small vertebrates.

AYE-AYE

Family DAUBENTONIIDAE

The **Aye-aye** is a Primate with a bushy, squirrel tail, large ears, and teeth like a rodent. Early zoologists thought it was some kind of squirrel; but despite its tail and its chisel-like incisors, its thumbs and the presence of a nail on its big toe show it to be a Primate. Like the other Primates it can oppose its thumb to the other fingers. Its rodent teeth (two pairs of chisselling incisors and no canines), indicate its way of life — it lives largely on the pith of bamboo and sugar-cane. It is an inhabitant of bamboo forests. It gnaws into the hard stalks with its incisors to reach the pith as well as any insects which may be hiding within the stalk. Probably it uses its strong teeth for stripping bark from trees when it is searching for insects and their larvae.

The aye-aye is nocturnal and arboreal. By day it sleeps in a hollow tree or in a temporary nest, coiled up with its tail round its body. It is completely fearless of man and defends itself with its hands.

LORISES, BUSH BABIES, ETC.

Family LORISIDAE

The main habitat of this family is the African Continent and India. The best known species is perhaps the **Slow Loris,** which is about the size of a cat and is found in India, Ceylon, Sumatra and Java. It has unusually fine, silvery-grey fur and looks like a plush fuzzy bear. Like a cat the slow loris cleans its fur with its tongue, but, in addition, it grooms itself with its teeth. The long claw on the second toe of its hind-foot is also used like a comb: the corresponding toe on the forefoot is stunted and is not used in this way.

The slow loris sleeps all day hidden among the leaves of a tree. Its sleeping position is unusual because it grasps a vertical branch with all four feet and sleeps curled into a ball, so that from a distance it looks like a plush ball adhering to the branch. After sunset it comes awake, slowly rubbing the sleep from its eyes, and goes off hunting for food. Slowness is typical of all its movements and thus it gets its name. It climbs slowly and deliberately, moving through the tree tops, sometimes along the underside of a branch, with slow hand over hand movements. The name "loris" comes from the Dutch word *loeris* meaning a clown, and the large eyes, facial markings and rather sad expression, fit the name.

When hunting, the slow loris stalks slowly and silently through the trees in search of small birds, insects and lizards, catching them with a final pounce like a beast of prey. It is an expert hunter of insects. The slow, deliberate hunter suddenly flicks out a paw and the insect is in its grasp. The loris also eats some fruits and berries.

The hands of the loris can grip like pincers so that it is able to hang by one limb and feed. It can hang for long periods without tiring because of the well developed thumb and big toe and the special supply of blood to the muscles. It rarely descends to the ground although it can be attracted there by some titbit. When picking this up it will usually hang on to the tree by at least one limb. It appears to be actually afraid of crossing open ground.

In this species, the active and resting periods are exactly divided. It sleeps for twelve hours and is active for twelve and a Czechoslovakian zoologist has described how he confirmed this. He locked the animal in a large aquarium with a moving floor. From this floor a thin string was extended to a moving drum on which every movement of the loris was marked by a wavy line. When the animal was asleep the hand did not waver and only a straight line was drawn; when the animal was awake the wavy line was drawn. Thus a mechanical device confirmed the clear division of the loris' daily cycle.

The next step was to prove that this regularity was related to light. The experimenter turned day into night by shutting the loris up in a completely dark room by day and exposing it to electric light by night. The loris very quickly reversed the order of its sleeping and waking. During the day it moved about the darkened room and slept when the room was lit up at night. Bright light irritates the large nocturnal eyes of the loris and if it is taken out in bright sunshine it immediately covers its head with its forepaws and the tears stream from its eyes.

This loris disliked having its cage cleaned, despite the fact that it was extremely clean in itself and its silvery grey coat always had a perfect gloss. It became angry if the cage was washed and soon the reason was plain. The slow loris, like some other animals, marks the boundaries of its territory and in so doing uses the same method as the dog. As it moves it sprinkles the branches with its urine, which has a strong but not unpleasant smell. Every time the cage was cleaned and washed, the loris had to begin marking its territory all over again and after each cleaning had to drink a great deal of water to produce enough urine for marking.

In captivity, the slow loris soon becomes tame and begins to recognise its keeper. It is accommodating as far as food is concerned and will eat all sorts of fruit, including cherries, apples and pears and will not refuse cooked rice or carrots. However, the preferred titbits are insects, mice and sparrows.

Two other relatives of the slow loris live similar lives. The first of these is the **Slender Loris,** which is only $9^3/_4$ inches long. It has a strikingly coloured coat, shading from rust to yellowish grey, which is as fine and soft as velvet. Its spindly legs, grasping hands and feet, and stealthy movements remind one of a chameleon.

The slender loris is nocturnal and sleeps by day curled into a ball high in a tree, with its head tucked between its hind-legs. In this position it looks like part of the tree.

At sunset it awakens and makes an elaborate toilet before moving off to feed. The main food is insects, small birds and lizards, but captive slender lorises will eat a lot of fruit. This species is found in Southern India and adjacent islands.

Africa has one relative of the Indian loris, the **Potto,** or **Bosman's Potto.** This species is about the same size as the slow loris but has a longer muzzle and is less conspicuously marked about the face and head. Its coat is more yellowish or rust-coloured. On the neck and upper vertebrae of the spine there is a series of thorn-like growths, long enough to be felt through the fur and clearly seen if it is parted.

A further member of this family is the **Galago,** or **Thick-tailed Bush Baby.** There are several species in this group. Unlike the loris, the bush baby has a long, bushy tail and prominent, hairless ears with many folds inside. The sense of hearing is highly developed and the bush baby always tries to protect its ears and folds them up when moving from branch to branch to avoid injuring them. It also sleeps with its ears folded up and for the same reason as opossums do — to exclude sound. They are so highly sensitive that the slightest rustling would waken the animal and it has to fold its ears so as not to hear. The bush baby's large eyes have good vision.

The thick-tailed bush baby is one of the largest species, measuring $27^1/_2$ inches in overall length, of which $14^1/_2$ inches is tail. The body is covered with thick, brownish-grey fur. Its habits closely resemble those of the loris. It wakens at sunset and hunts during the night, feeding mainly on insects and small vertebrates which it pounces upon with great speed. It moves about silently and nimbly and can make spectacular leaps from branch to branch. On the ground, it can leap like a kangaroo. Although a predator, the thick-tailed bush baby likes sweet fruit.

This species has one or two young at a birth. At first the female carries them

I 1. *Potto* 2. *Ruffed Lemur* 3. *Eastern Tarsier* 4. *Ring-tailed Lemur* 5. *Aye-aye* 6. *Slow Loris* 7. *Slender Loris*

around, but soon they are left in the nest because of their weight. They are weaned at the age of three to four months but are slow in maturing. Gestation period is 120 days.

The thick-tailed bush baby is more aggressive and appears to be more solitary in habits than other members of the group.

A traveller called Kersten has described how natives catch the thick-tailed bush baby:

"When palm wine is being drawn, the galago comes to the house like an uninvited guest, for it loves wine and often becomes drunk on it. When it is too drunk to move it falls from the branch and lies where it has fallen. The natives then pick up the motionless sleeper and put it in a cage, or bind it with rope wound round the groins. In the morning, they carry it off to town and offer it to the Europeans who buy animals."

The thick-tailed bush baby has a distinctive mewing cry, very much like a small child's. It has another call, which has been likened by travellers to the cooing of pigeons. One bush baby, which escaped from a zoo and disappeared, was latterly located by its cries which sounded like the cries of a person in distress. The animal was found sitting in a larder feeding on roast chicken.

Thick-tailed Bush Baby

TARSIERS

Family TARSIIDAE

The Tarsiidae are so-named because of the long instep on their hind feet. There are three species.

The **Eastern Tarsier** of the Malayan archipelago measures nearly 16 inches in length, including its tail of nearly 10 inches. The most striking thing about it is its round head and enormous owl-like eyes. The hairless ears are joined to the head by a short stub. The neck is so short that the head appears to be joined directly on to the body. The fore-limbs are very short, but the hind-limbs are longer than the body. Another remarkable thing about the tarsier is its fingers — they have wide ball tips, in which they resemble the tree frog's, but the flat nails and the opposed thumb betray the animal's real affinities. The teeth closely resemble those of the insectivores. The fur is greyish-yellow to greyish-brown, with a fine reddish tinge

and there is a tassel of long, yellow hair on the end of the long tail.

The tarsier is a nocturnal animal and well adapted for hunting at night. Its mixed diet includes insects, lizards, young birds and eggs, and sweet fruits. Little is known about its way of life because it is rare even in its own habitat. Probably it is a social species because animals have been found living together in the wild state.

Besides having fingers like a tree frog, the tarsier moves like a frog, making great leaps in the branches for a distance of up to six feet. Because of the special adhesive pads on its feet it can cling to the smoothest of branches. When it leaps it holds its tail out horizontally. When it alights the tail comes up over its back and it spreads its feet as shock-absorbers. It snatches its prey in both hands when it pounces. It is not shy of human beings and more than one animal has been caught by leaping on to the person watching it.

The tarsier is rare in zoological gardens because it is difficult to keep alive, even under the best conditions. Only in recent years have some American zoos succeeded in breeding it in captivity. The female does not carry her young against her abdomen but in her mouth like the insectivores. We see, therefore, that the Tarsiidae are closely related to the insectivores which were the ancestors of the Primates. The tarsier itself is one of the most important links in the evolutionary chain and helps us to understand the most complicated of all, that of man himself.

ANTHROPOIDS

This sub order of the Primates includes many more species than the Prosimiae, or semi-apes, and about four hundred living species have been described. There is no doubt that the anthropoids are the most popular of all the mammals in zoological gardens, and in a popularity poll the monkeys would surely win. Monkeys attract people by their human attitudes and gestures.

The anthropoid body is adapted to moving about in trees, and in most species the thumb can be opposed to the other fingers. The palms and the soles of the feet are hairless; on the cushions of the fingers there are special lines which form a variety of patterns. These lines enclose the touch cells, named touch lines by the experts. The corresponding patterns on the human fingers are studied mainly by detectives and are the patterns that register in finger-printing.

Most anthropoids have flat nails on their fingers and toes and only in a few species have the nails changed into claws. The anthropoids walk on the ground on all fours but step on the entire sole of the foot as people do. They are referred to as plantigrades. Occasionally, they will walk erect like a man, keeping the hands clear of the ground. This, however, is exceptional and they walk like this only for short distances or when playing. They cannot walk completely erect because their spine is not adapted to it. The human spine is curved twice to form the shape of the letter "S", one curve being in the region of the neck, the other in the region of the hips. Monkeys do not have the spinal curve in the hip region and so cannot walk erect but have always to lean a little forward. Nor can they straighten their knees, which remain bent even when they are standing erect.

The skull of the anthropoid, particularly that of the young animal, is more oval than that of other mammals. In certain species, the skull becomes elongated as the animal becomes older, thus losing its original roundness. However, if we compare it with the skull of other mammals we see at once that it is designed to protect the larger brain and that is why one of its basic features is its size.

The eyes of the anthropoids look to the front and all monkeys, like man, are guided chiefly by sight. This explains why all monkeys, with a single exception, are diurnal. They go to sleep at dusk and wake up at dawn.

Other senses are not so well developed. The sense of hearing is about the same as that of man, and the sense of smell, although better than that in man, is much less developed than in most other mammals. Nevertheless, we can see from the behaviour of captive monkeys that they are guided, to some extent, by their sense of smell. If a man shakes a chimpanzee by the hand, the animal smells the paw immediately afterwards, presumably to find if it has shaken hands with someone already familiar to it.

Anthropoids are divided into two great groups according to the shapes of their noses. One group is the flat-nosed monkeys, the other the narrow-nosed monkeys. In the flat-nosed monkeys, the nostrils are set wide apart and directed sideways. This group inhabits the New World (South America), and is also referred to as the New World monkeys. The narrow-nosed monkeys have the nostrils set close together and opening downwards as in man. This group inhabits the Old World (Europe, Africa and Asia), and is referred to as the Old World monkeys.

A characteristic of all monkeys is their hairless face and the numerous facial muscles under the skin. These are mimic muscles because when they contract they change the expression of the face, thus changing its mimicry. Man, too, has many mimic muscles which express his state of mind. If a man is angry he frowns; if he is pleased the mimic muscles stretch out and a smile appears on his face. In this respect monkeys are very like human beings because they are able to frown, express discontent, anger or excitement, thus differing at the same time from other mammals whose facial muscles are much less developed.

Now we arrive at the most interesting and difficult problem of all in the life of monkeys. We have just seen that monkeys, particularly the large apes, can express pain and pleasure and other feelings on their face. A question that is much more difficult to answer is whether or not monkeys are able to think.

Let us say right away that thought in monkeys cannot be compared with thought in man. Old Natural History books mistakenly attributed human qualities and abilities to many animals. In other words, they humanised them. Scientifically, this kind of humanising is called anthropomorphism.

Numerous experiments have been carried out on chimpanzees and these show that the animals can carry out many tasks given to them by man and can carry them out much faster than any other mammal. We must realise, however, that animals can be given only such tasks as they are capable of performing. Every animal is first of all perfectly adapted to the environment in which it lives, and environment is a big influence on the development of all the animal's bodily functions. Here is an example. A horse cannot turn the pages of a book, but every semi-ape and anthropoid can do

so with its skilful fingers, but this does not mean that the horse is stupid and the monkey clever. A horse's foot has only one toe, enclosed in a hard hoof, and it could not perform such a task. On the other hand, a horse is capable of doing things which no monkey can do. This example is introduced to show that it is unfair to compare animals by human standards. An animal can do only what it needs to do to survive. The human brain has had to develop a long time to reach its present perfection.

Now let us come back to the monkeys. Many experts have attempted to determine the ability of monkeys, particularly the anthropoids, by a variety of experiments and many thousands of these have been carried out. For example, when a bunch of bananas was placed too high for a chimpanzee to reach them, the chimpanzee looked for a stick and knocked them down. In the next experiment, the bananas were put still higher so that the chimpanzee could not reach them with the stick, but, again, it knew what to do. It fetched two boxes and placed one on top of another, then climbed up and knocked the bananas down with its stick.

Now the experimenters tried a still more difficult experiment. They hung the bananas high up and filled the boxes with sand. The chimpanzee emptied out the sand, piled up the boxes and reached the bananas as before. After this experiment, the boxes were removed and the chimpanzee was given two sticks, one of which was hollow so that the other could slip into it. Again, the chimpanzee knew what to do. It joined the sticks together and knocked the bananas down as before.

Chimpanzees soon learn to tell the difference between coins, and once an animal has learned the difference it will always put the right coin in a slot to get sweets.

An American research worker, Yerkes, has reported an interesting observation on chimpanzees. Ants had made several paths along the outside of the chimpanzees' cage and these they assiduously followed. The chimpanzees soon learned how to catch the ants. They took a grass blade, wet it with saliva, and put it in the ants' path so that they stuck to it.

Nevertheless, even after such experiments, it is not yet possible to say with certainty just how far such actions are instinctive and how far they are the result of independent thought. The most we can say about the brain of the anthropoids, at this stage, is that all monkeys have a brain and a mental ability which are the best developed among all mammals, but there is never any question of their possessing a thinking ability comparable to man's.

The chimpanzee can put on an extremely sad expression, but this is never sadness in the human sense of the word. The greatest sorrow cannot cause the shedding of a single tear, and probably the chimpanzee is incapable of experiencing real depth of sorrow. Perhaps this sorrow can be compared to that of small children who are sad if a favourite toy is taken away but happy again the moment they get it back. All the expressions of monkeys are far more simply based than those of human beings. But for us they are instructive because they reveal from what simple beginnings the complicated process of human thought evolved.

Although monkeys resemble man in general appearance, there are many physical differences, as well as similarities. The tapering ear has been replaced by the rounded form found in human beings. Most monkeys have thirty-two teeth, which is the number

found in man. But in some species, the canines are remarkable, being long and pointed like those of carnivores. In fact, the teeth of anthropoids can be powerful weapons and even large beasts of prey will not lightly provoke a powerful baboon. In many monkeys there is a kind of cheek pouch inside the mouth, very like the cheek pouches of the hamster. If you observe monkeys in a zoo you will sometimes see an animal with a lump in one or both cheeks. But this does not mean that the animal has toothache. It is merely hiding surplus food from other monkeys in the cage.

Another interesting point about monkeys is their vivid colouring and, in some species, the naked buttocks. Baboons are particularly striking in this respect; in the female baboon these bald, coloured parts swell during the mating season until they look like tumours and this is an indication that the animal is in rut or heat. Mating behaviour and physical appearance vary from species to species. For example, a rutting stag grows a mane, while a female baboon exhibits swollen buttocks.

In monkeys the period of gestation varies according to the species. In the smaller species, it can be four or four and a half months, while in the largest it lasts for nine months which is the same as in human beings. The young are comparatively smaller than human babies at birth, but, unlike human babies, they develop much more quickly and can move about unaided soon after birth.

The female monkey carries her young about with her in the early stages and protects it at all times. Flat-nosed monkeys carry their young on their backs, while the narrow-nosed monkeys carry them on their abdomen. Only when she is completely satisfied that no danger threatens will the mother allow her young to move about alone on the ground and, even then, the young animal is not without some supervision. The young of most monkeys are mature after a period of four to seven years, but in chimpanzees, orang-utans and gorillas the period is eight to twelve years. Compared with other mammals of their size, monkeys are long-lived. The small rhesus monkey can live for twenty-five years, baboons for forty-five years and the larger apes up to fifty years or more.

A characteristic of most monkeys is their gregarious way of life. In the wild, we find them living in larger or smaller groups, which are always led by an old and powerful male, and all members of the group obey the leader unquestioningly. The leader demands absolute obedience and rules with an iron hand, tolerating no opposition. In zoological language, this means that the group has a leader or dominant male to whom all the others are subordinate. If the group comes upon a plentiful food supply the leader is the first to eat his fill; the other members then feed on what is left. If a subordinate male tries to intrude too soon, the leader assaults him at once and drives him off. Sometimes the leader will even open the other's mouth by force and scrape the titbit from his cheek pouch. Judged by human standards this behaviour may seem brutal and selfish, but in the world of monkeys this behaviour has evolved over a long period and must, therefore, have value to the species.

The leader of a group is not only the strongest member, he is also the most experienced and capable. He is able to recognise all enemies on sight, knows how to avoid them and how to face them if necessary. He is familiar with his whole range and knows the best escape route for the group if an enemy threatens, and the best hiding places. This is why the leading male eats first: he can keep watch on the whole group afterwards and warn

it in time of any impending danger. All modern zoologists who have studied monkeys are agreed on the value of an experienced leader for the group.

If any member of a group is shot, the other members flee in good order following their leader. But if the leader himself is shot, great confusion arises and the monkeys flee in all directions and it is unlikely that the group, as previously constituted, ever comes together again. If a group has to cross or pass through a dangerous area, the young animals go first, then the other members of the group and, finally, the most important member, the leader himself.

Of course, group leadership demands a male of very special fibre and not any male can become a leader. The leader must be capable and he must be prepared to fight hard to retain his leadership. When he grows old or weak he is overcome and ruthlessly deposed by the animal who is second in dominance.

The relationship between individuals in a group is not unlike the relationship in a flock of poultry, where there is a definite peck order. One can see that all the members of a group accept an order of precedence and are ranged according to a definite degree of subordination. The highest position is occupied by the male leader, the lowest by the youngest or weakest member. Any animal in the group is subordinate to all his superiors and superior to all his subordinates. That is why fierce struggles go on in every group of monkeys between members trying to better their position in the group and consequently their way of life. This goes on all the time, because individual animals weaken with advancing age and old and sick animals descend lower and lower down the ladder of rank. Subordinate animals must honour and obey their superiors and greet them as superiors when they meet them.

Nowadays, zoologists can understand many of the greetings and expressions of subordinates among animals. For example, a baboon greets his superior by turning his back. In a zoo a monkey will often turn its back on people, but it does so to greet a superior, or superiors, and not because it is ill-mannered or has taken a dislike to people. Some uninformed people even suspect that the keeper teaches such bad manners to the monkeys on purpose. For the person working with animals it is very useful to understand the significance of such behaviour. Thus if a monkey greets us we can enter its cage without fear, for it will never attack a superior, but if it does not greet us in this way then it is dangerous to approach it, for it is usually a powerful male who does not greet but awaits to be greeted. He is, therefore, prepared to fight us to assert his superiority. However, man being a thinking animal, knows perfectly well that he cannot win in a struggle with a strong ape armed with gigantic canine teeth. Thus he does not reply to the intended provocation, but simply refuses the invitation to a duel.

An interesting outward sign of reciprocal friendship among monkeys is "flea-catching". All people who visit zoos are familiar with it, but very few know that the monkeys are not catching fleas at all. Monkeys, in fact, are very sparsely haired so that fleas do not flourish on their bodies and we never find them there. It is not fleas the monkeys are looking for but dandruff; that is small scales that flake off the dead skin. These scales absorb sweat and have a salty taste; therefore in picking each other's dandruff, the monkeys not only express their friendship and gentleness to each other, they enjoy eating the salty flakes of skin.

As we have seen, the flat-nosed monkeys have widely separated nostrils which open sideways. Most monkeys of this group live in South America, although some species are also found in Central America. Of all the monkeys the flat-nosed species come closest to the semi-apes that were their ancestors.

The flat-nosed monkeys live what might be described as a primordial life, for most of them, like the semi-apes, spend their lives in the tree tops and rarely descend to the ground. Even when quenching their thirst, they will lick the dew from the leaves, or hang down from a branch or a liana to reach water.

The tail of the flat-noses has developed in an interesting way, being in many species equivalent to a fifth limb. A flat-nose can hang downwards suspended by its tail, a feat of which not one Old World monkey is capable. At the end of the tail there is a hairless part whose function can be compared to that of the human finger. The tail is very sensitive because on this bald patch are numerous touch lines and touch cells like those on the fingers.

Flat-nosed monkeys live a secretive life in the tree tops and the rich American jungles afford them a diverse food supply: sweet fruits, birds' eggs and young, small vertebrates and insects. The fact that they feed so largely on animal food distinguishes them from their predominantly herbivorous Old World relations. Although the damage done to plantations by flat-nosed monkeys is insignificant, man persecutes them. The Indians hunt them with poisoned arrows, which they shoot from blow-guns. The poison has an almost immediate effect on the monkey, which falls from the tree like a stone. The meat of the monkeys is said to be good and their pelts are used by the Indians for all kinds of decorative purposes. Apart from man, predators on the South American monkeys are large snakes and carnivores. Among birds of prey, the harpy-eagle is a specialised predator on these monkeys.

Flat-nosed monkeys are not often seen in zoos because they do not survive captivity well and are difficult to feed.

MARMOSETS AND TAMARINS
Family CALLITHRICIDAE

Marmosets are the smallest known monkeys and are found in South America in the region of the Amazon. They are about the size of squirrels, and their movements are squirrel-like. They are often referred to as Clawed Monkeys because they have claws on fore- and hind-feet instead of nails. These enable them to climb like squirrels straight up or round the trunk of a tree, grasping the bark with their claws. They can move up, down and around tree trunks with the agility and speed of squirrels, but they seldom leap. When they have to jump, as when they are being hunted, they are more than likely to fall short of their mark than to reach it. Among monkeys they are the awkward jumpers.

Unlike other monkeys the marmoset cannot oppose its thumb to the other fingers of

the hand. The big toe, on the other hand, is clearly separate from the others and, unlike all the other digits, has a nail instead of a claw. The possession of claws instead of nails is considered to be a specialisation to suit the marmoset's squirrel-like behaviour rather than a surviving primitive feature.

Marmosets live in small troops. They wake up at sunrise and are active most of the day, climbing up the giant forest trees. They are quarrelsome animals, forever squabbling amongst themselves and baring their sharp pointed teeth. Their voice is a high-pitched twitter, sometimes in the supersonic range. Their diet is made up of insects, spiders, young birds, fruits, shoots and other plant food.

With the coming of dusk the marmoset troop becomes quiet and each animal seeks its hollow tree to sleep in. They sleep curled up into a ball with their long, bushy tails covering their head and body.

Female marmosets bear two or three mouse-sized young at a birth. A mother with twins will carry one young on her back and hold the other against her abdomen. Sometimes a male will carry a young one, a rare occurrence among monkeys.

A variety of birds and mammals prey upon the marmoset. Man is also a predator, but although the Indians hunt them for their meat, they keep them mainly as domestic animals because of their beauty. Marmosets, in fact, are easily tamed and soon become attached to their owner. Indian women put marmosets in their thick, black hair as decorations. Keeping marmosets in foreign zoos is quite another matter because of the difficulty of feeding them.

The most numerous member of this family is the **Common Marmoset.** This species measures up to $9^3/_4$ inches in body length. Its bushy, black and white striped tail measures up to nearly 14 inches long. The body is rusty yellow in colour, flecked with black and white. The common marmoset has a white spot on its forehead and striking white ear tufts.

Common Marmoset

The common marmoset is often imported by European zoos. When tame it becomes very affectionate. Like all marmosets it has excellent colour vision so that it can recognise a person a long way off. The marmoset's usual welcome to a known person is to greet him with high-pitched bird-like cries. Some zoologists maintain that the marmoset can attract birds by such cries, but this is by no means clear. Birds are, however, a favourite food and if a bird approaches too closely the marmoset will snatch it by a wing and bite it through the head with its sharp teeth.

One of the most striking clawed mon-

keys is the **Golden Marmoset,** or **Lion Marmoset.** It is larger than the common marmoset, its body being about 14 inches long and its tail about the same length. It has fine, thick, shimmering golden-yellow fur; in sunshine the fur literally glows like gold. The species gets its name from the great mane formed by the hair on its head, neck and shoulders. The tail of the golden marmoset is narrower than that of the common species, but thickens towards the tip.

The **Pygmy Marmoset** is the smallest of the group and therefore the smallest living monkey. Its maximum overall length is 12 inches, and half of this is tail. This is the least conspicuously coloured of the marmosets, the general appearance being mousy. The fine fur of the head and neck forms a mane round the small face. The pygmy's colouring makes it difficult to see.

Like all the marmosets, the pygmy is arboreal and diurnal. It can climb at high speed and its movements are almost too swift for the eye to follow as it moves through the maze of branches and lianas. Like all its relatives, it is however a poor jumper. Squirrel-like, it will hide behind a tree and peer round it at an intruder.

The pygmy marmoset has been bred in captivity. The female usually has two young at a birth after a gestation period of 140 days. Soon after birth, the young

Pygmy Marmoset

are handed over to the male who carries them about with him and passes them back to the female only to be suckled.

Although usually considered a very rare species, the pygmy has recently been recorded in areas where its presence was not suspected. Because of its shy habits and inconspicuous colouring, it might well be more common than is generally supposed.

NEW WORLD MONKEYS
Family CEBIDAE

The New World Monkeys are medium-sized animals with long tails. In many species the tail is prehensile. Unlike the marmosets, the females of these species bear only one young at a birth, which the mother carries on her back.

Night Monkey

The **Douroucouli,** or **Night Monkey** sometimes called the Owl monkey or Night ape because of its nocturnal habits, is the only true monkey which is nocturnal. It is about 3 feet in overall length, of which 1½ feet is tail.

The ears of the night monkey are hidden by the thick fur. The naked face has a black fringe giving the impression of the facial disc of an owl. The eyes are large and cannot stand strong sunshine.

During the day, the night monkey sleeps in hollow trees but its sleep is not so profound as that of the semi-ape and it is easily roused by day. Travellers have reported seeing night monkeys peering at them from their sleeping quarters by day, blinking in surprise and query. This habit makes them easy to catch.

At sunset the night monkeys go out to hunt. They feed mainly on insects, birds, bats, fruit and leaves, and seldom need to drink. One young at a birth is usual and the male helps with the rearing of the young, sometimes carrying it around on his body.

Titi

The **Common Squirrel Monkey** is the smallest of this group. When fully grown, the body length is 12 inches and the tail is 20 inches. The fur is short and varies in colour from yellow-green to orange; the limbs are rusty yellow and the abdomen white; the tip of the tail is black; the ear tufts are white; the face white and the muzzle black.

Squirrel monkeys are active throughout the day and move about in troops of up to one hundred animals. They can move nimbly in the highest and thinnest branches. During the noonday heat they rest. When active, they are noisy and quarrelsome. At night they sleep with their tails wrapped round their bodies for warmth and there is much jostling and squabbling for a central position in the troop.

The **Titi** inhabits the tropical jungles along the banks of the Amazon and Orinoco rivers. There are several races.

Body length is about 3 feet; the tail

measures 18 to 20 inches. The body is reddish-brown in colour but the forearms, hind-legs and tail are black. The hands are white so that the titi appears to be wearing white gloves. The fur on the face is white but the skin underneath is black so that the colour of the face looks bluish. The throat is snow white and there is a black collar round the neck.

All the titi monkeys are omniverous, feeding on birds' eggs, small birds, insects and fruit. They live in small family parties and make a great deal of noise, especially in the early morning Not much is known about their life in the wild as they live in the highest branches and hardly ever descend to the ground.

The **Red Uakari** is one of three species, all of them comparatively rare and inhabiting the jungles of the Amazon and its tributaries. The Red Uakari is a striking animal with rich golden-chestnut hair and scarlet face and head. This colour deepens when the animal is afraid or has been disturbed. The tail of the red uakari is comparatively short and is useless as a balancing pole. Although rather clumsy in its movements, the red uakari climbs well and can leap with ease and precision; sometimes it will run along a branch upright on its hind-legs, using its arms to balance with. More usually it moves about on all fours.

Red uakaris live in small troops and are usually retiring and timid, but the male can be aggressive when his mate or young is threatened. Their main food is vegetable matter, including fruits and nuts. In captivity the red uakari soon becomes apathetic and does not thrive.

The **Hairy Saki** is one of three South American saki monkeys, all of them rather

Red Uakari

strange creatures in both shape and colouring. Superficially they are the least monkey-like of monkeys. Their face is that of a melancholy old man. They have canines like a cat, and a voice like a bird. They can leap like the semi-apes and walk erect like the true apes. They have the bushy tail of a fox. The most striking thing about

Hairy Saki

them is the hair which grows on their head and shoulders. This forms a tousled, bristly cape. Sakis live in the highest tree tops, leaping from branch to branch, running up and down the lianas or along branches like tightrope walkers, holding their arms above their heads. When feeding they will hang upside down, grasping with their hind-feet and collecting fruit with their hands. They feed on fruit, grain, shoots and leaves, but also take small birds, bats and mice.

Sanderson, who spent some time in the South American jungles, once watched a whole troop of sakis entering and leaving a hole in a large tree. He discovered that the sakis were collecting sleeping bats and eating them with great gusto.

Very little is known about the life of the sakis in the wild state, but it is known that the mother frequently carries her young in her hand by the scruff of the neck. At other times, the young will cling to its mother's abdomen. The sakis live in troops of up to ten animals and spend all their time in the trees. They rarely drink and hardly ever descend to the ground. Although, in South America, they are often kept in captivity they are among the most difficult animals to keep in zoological gardens and rarely survive for long. They are easily frightened and readily panic at the slightest change in their surroundings.

White-throated Capuchin

The **Capuchin Monkeys** are the commonest South American species seen in zoos. They are mostly brown, medium-sized monkeys, recognisable by the cap of stiff, bristly hairs on their heads. Capuchins, indeed, have a black cowl of hairs resembling the cowl of the Franciscan monks, hence the name.

There are several species of capuchins, found from Nicaragua to the Northern Argentine, but they are often difficult to distinguish from each other.

The **Brown Capuchin** has tufts of hair, resembling short horns, on each side of the crown. The tail is long and bushy. When the capuchin runs on the ground or along a horizontal branch the tail is curled into a spiral, but the monkey, when climbing, winds it round the branches. The tail is, therefore, semi-prehensile. Although the capuchins live in the tree tops and are extraordinarily agile, they hunt a great deal on the ground and are perfectly at home there. They will raid cultivated areas for fruit and maize. In the forest their food consists of fruit, leaves, small birds, insects, larvae and spiders.

Capuchins are intelligent and very capable with their hands. They will use simple tools such as a heavy stone to crack a nut. For small nuts they use small stones and for very hard nuts they will use bigger ones, sometimes as heavy as the monkey itself. They are so skilful that they seldom hit their fingers and when they do they will suck the wounded finger just like a human being.

Like chimpanzees, the capuchins will reach any titbit that is placed too high for them, either by using a stick or by climbing on top of several boxes to reach it. Further proof of their mental ability is that they can recognise a favourite titbit,

Brown Capuchin

even on a picture, and become extremely excited when they see it. Capuchin monkeys have even tried to draw and paint.

The wild troops are led by a powerful male whose rule is absolute. He chooses the best sleeping place and the choicest titbits. To attain this position he has to fight many duels. Such fights sometimes result in a weaker animal being killed. Captive capuchins have inflicted deep wounds on human beings with their sharp teeth. This behaviour persists in zoos, which worries the keepers.

Schomburg, who observed capuchins in the wild state has described a scene which demonstrates the attachment of the mother capuchin to her young. The Indians in the party had shot and wounded a female capuchin. Although she was aware of the danger threatening her and was suffering terrible pain, she turned back for her young. Ignoring the group of people gathered around the young animal, which was calling plaintively, she gathered it up and pressed it gently to her breast for the last time.

Indians hunt capuchin monkeys mainly for their tasty meat. Europeans, however, do not like the meat because it tastes of musk. In addition to using the capuchin for food, the Indians make articles of clothing from the fur as well as various personal adornments.

The **Howler Monkeys** of South America are distinctly bearded. They have prehensile tails, bare and sensitive at the tip. Their powerful voice has given them their name.

Usually the largest male howls but when a whole troop does so the sound can be heard two or three miles away. Other troops within earshot will take up the howling which may go on for several hours. This howling, like bird song, announces the holding of territory. The volume of the sound is produced by means of a bony drum in the throat which amplifies it. The drum is a modification of the hyoid bone and the throats of the howler monkeys have become enlarged to accommodate it.

Howler monkeys live together in small troops, usually made up of three males, eight females and their young. The troop is not, however, led by a single male; all three share the task of governing and the troop lives in harmony.

Howler monkeys never leave the tree tops. They fear the ground and when they want to drink they hang down from the lowest branch over a river or pool. South American travellers have reported that in times of flood, the howlers prefer to go hungry in their tree tops rather than swim the short distance from one tree to another. In the trees, they move about easily, swinging from branch to branch with their hands, using their tail as a fifth limb, or swinging by it alone. When leaping from one tree to another, they can cover a distance of more than twelve feet.

The main food is leaves and tree shoots and they are entirely vegetarian. They range widely for their food and are not satisfied with the leaves or fruits of one species of tree. This is a problem where howlers are kept in captivity because it is difficult to give them a sufficiently varied diet or to provide them in winter with the type of food they require.

In the wild, howler monkeys have many enemies, including man who hunts them for their meat and fur. Next to man there are the beasts of prey that can climb trees, and certain birds of prey, especially the harpy-eagle.

Black Howler Monkey

The **Red Howler Monkey** lives in Colombia and along the central Amazon. Other species occur in other parts of South America which differ from the red howler mainly in colour. It has been said that the fur colour is not fast and that it can change after a soaking in water. The **Warine** is the best known of the howler monkeys. It is about $4^1/_4$ feet long, which includes a tail of $2^1/_4$ feet. In this species, the males are black; females and young are straw coloured.

The last genus of the Cebidae are the **Spider Monkeys,** which differ from the other flat-noses in having a very short body and very long limbs and tail. They have small, round heads. They are the most accomplished climbers of all the South American monkeys; on the ground, however, they move about awkwardly. Of all the Cebidae family they are the most perfectly adapted for their life in the trees.

In the Spider monkeys the thumb is stunted and in some species missing altogether, but this is no handicap as the other four fingers on the hand are used as a hook. The spider monkeys tend to swing underneath the branches, hand over hand, and in this way they can sometimes span distances of thirty feet or more. The tail is a fifth limb, being long, strongly muscled and prehensile, with a naked tip that is extremely sensitive. Spider monkeys can hang by their tails for hours on end. The tail has other uses; the monkey can pick up fruit with it and uses the tip as a touch organ for examining objects.

The female spider monkey carries her young on her back with its tail curled round her body. And she can execute the most intricate acrobatic feats with it in this position. Spider monkeys are diurnal and vegetarian. At sunset, the whole troop settles down to sleep. They nestle close to each other with their tails curled round their necks.

The **Black Spider Monkey** is the largest and the most widely distributed of the group. It measures $4\frac{1}{4}$ feet from nose to tail tip. It is entirely black, except for the face which is flesh coloured. This species is the one most often imported by zoological gardens, but all the prehensile monkeys are very delicate and require great care in captivity.

Black Spider Monkey

The largest of the flat-noses and largest of South American monkeys is the **Woolly Monkey,** which measures about 5 feet long, including $2\frac{1}{4}$ feet of tail. It has long, thick, fine fur. The thumb of the woolly monkey is better developed than that of other prehensile monkeys but the tail is not nearly so perfect as a fifth limb.

South American Indians call the woolly monkey, *barrigudo*, and declare that its meat is the finest of all. As a result, the species is constantly hunted and in the vicinity of inhabited settlements has been almost completely exterminated.

NARROW-NOSED MONKEYS

This group comprises all the monkeys that inhabit the Old World — Africa, Asia and Europe. The group is divided into three families, the last of which is man.

MACAQUES, BABOONS, LANGURS, ETC.
Family CERCOPITHECIDAE

This large family includes the greatest number of species. These differ in several important ways from the other narrow-nosed monkeys. First there is the hair, which on the forearms grows downwards towards the hands. The forelimbs are shorter than the hind-limbs and all Guenons step on the whole palm of the hand and the sole of the foot. Most of them have cheek pouches in which to store food.

The guenons are small to medium-sized monkeys, living mainly in Africa; a few species are found in Arabia. In many ways they are cat-like and in old books on natural history they were described as Sea Cats as a result of a mistake in translation. Although cat-like they have nothing to do with the sea. They are jungle animals.

Guenons are excellent climbers and use their long tail as a rudder when leaping. It is not prehensile.

In the wild they live in troops, comprising twenty to forty individuals. The troop is made up of several families, which band together in daytime but separate at night. A powerful male leads and the other males, females and young are subordinate to him.

The guenons feed in daytime. They are entirely vegetarian, feeding on plants, tree shoots and fruit. They are very selective in their feeding, eating only part of a fruit and throwing the rest away. Thus, they destroy much more than they consume. This can mean considerable destruction in fields and gardens because guenons can consume one-quarter of their body weight in twenty-four hours.

The African traveller, Loesche, has described a feeding troop:

"... Led by an old, experienced male the whole troop of guenons approaches the corn field, the females carrying their young across their abdomen. The old leader shows the way and the others follow in his footsteps, using not only the same trees but the same branches as he. The old male climbs to the top of a tree to spy the ground ahead. If he is satisfied he gives his subordinates a signal by emitting a soothing guttural sound. If he is not satisfied, he gives a warning signal. On the forest edge the whole troop descends from the trees and races forward in great leaps to their destination. There, the monkeys become extremely active, at the same time keeping ceaseless watch on their surroundings. They pick wheat ears at great speed, filling their cheek pouches with grain until they look ready to burst. Only when their cheek pouches are full do they slacken the pace of their feeding. Now they become choosy, smelling every single ear before they pick it. And if there is something they do not like about it they immediately throw it away. Usually they pick only a few grains from each stalk and throw the rest away, and that is why the natives dislike them so very much."

An adult guenon taken wild cannot be tamed; this is only possible with young animals. Old ones remain bad-tempered and unreliable to the end of their days and can inflict severe wounds on their keeper with their sharp teeth. Hunters in Africa often capture a young animal by shooting the mother, but this is a wasteful and inhuman method. The more modern and preferred way is to dig pits baited with grain, or bananas. A noose is placed round the lip and the monkey is snared in this when it comes to feed. Another method used by some hunters is to place empty coconuts on top of poles on the monkeys' feeding ground. A hole is bored in the coconut large enough to admit the monkey's fist, and the coconut itself is half-filled with sweet grain. The hunters then hide in the bushes until the monkeys discover the bait. When the monkeys have pushed their fists inside the coconut, the hunters rush upon them with loud cries. The monkeys spread their hands as they turn to flee and, of course, cannot get them out. While they are trying to do so, the hunters throw nets over them and capture them easily. This inventive method of hunting is based on the fact that when a monkey is escaping from danger it always spreads its fingers.

II 1. *Golden Marmoset* 2. *Mona Monkey* 3. *Humboldt's Woolly Monkey* 4. *West African Green Monkey* 5. *Red Howler* 6. *Brazza's Monkey* 7. *Variegated Spider Monkey* 8. *Plain-headed Mangabey* 9. *Common Squirrel Monkey*

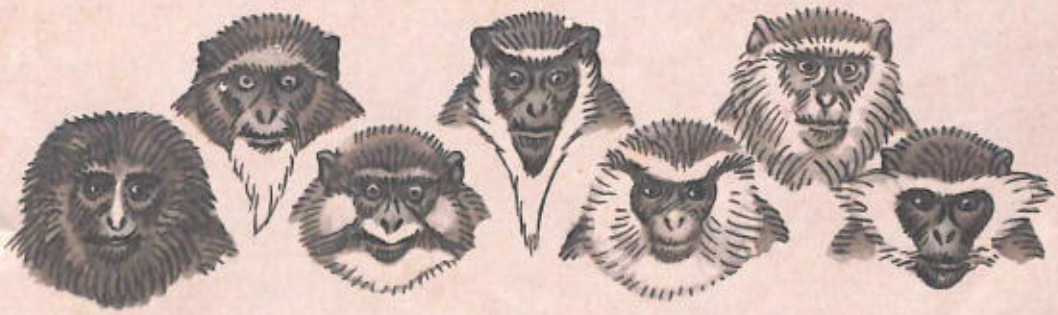
One of the best known guenons is the **West African Green Monkey,** or **Vervet Monkey.** This is the species most frequently kept in zoos. Its colour varies from yellowish- to greyish-green. The males have well developed white whiskers round their black, hairless faces. This monkey is widely distributed, ranging from Senegal to Abyssinia and down to South Africa.

Dr. J. Baum has written about the character and behaviour of the vervet monkey he had with him in Africa. The monkey was a male called Koko.

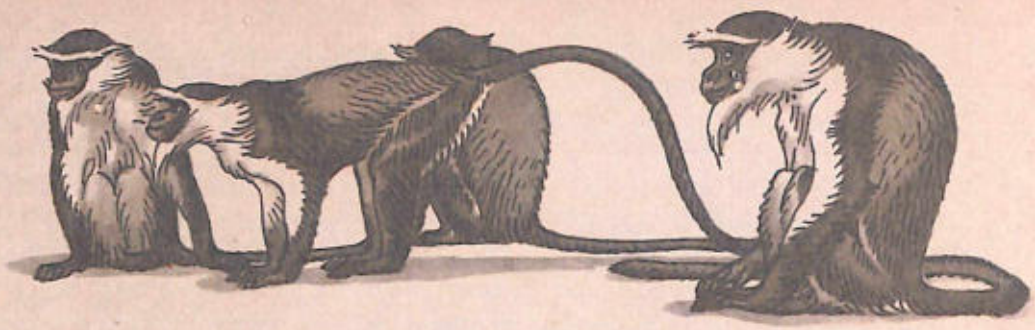
Dr. Baum writes: "Travelling in the car, he liked best sitting on somebody's knee and he looked out on the countryside with interest. He had excellent eyesight and was always the first to spot a herd of giraffes or a group of natives and then he jumped on to the roof of the car for a better view.

"He was not difficult about food; he was not even solely vegetarian and even enjoyed eating meat. Sometimes, during a meal, he got the idea that I had taken a better piece than he had and he would open my mouth to look for it. A time of feasting for Koko was when termites were swarming. He would fill his cheek pouches with them. He was just as fond of locusts. He would crawl under my berth at night when he heard a lion's roar. The only creature bigger than himself that he did not fear was man. Strangest of all, he feared other monkeys as though he had forgotten his origin. On the other hand, he liked to play with children, dogs and cats. As long as we lived in the wild, the points for and against my little monkey were more or less even, but in civilisation and large towns difficulties began. Sometimes, he wanted to play in the street with strange people who were not used to having a monkey leap suddenly on to their shoulders and pull their ears. In the jungle it was a great event for Koko to find a bird's nest with eggs and so a shop in Cape Town selling eggs seemed a wonderful dream to him. When I discovered him he was carrying away as many eggs as he could and continually dropping them on the ground. Koko died on board ship, travelling from Cape Town to Europe, probably the result of a chill."

Brazza's Monkey is one of the largest guenons and the most handsomely marked of them all. It is greyish-green in colour and lightly speckled, with an orange headband lined with black. Adults have a prominent white beard and whiskers; the hands and feet and the outside of the limbs are black. Brazza's monkey feeds on



Heads of monkeys from left to right: Hamlyn's Monkey, Brazza's Monkey, Moustached Monkey, Diana Monkey, Mona Monkey, Hussar Monkey, West African Green Monkey



Diana Monkey

vegetable and animal food and inhabits the jungle areas along the banks of the Congo, down to the White Nile.

The **Moustached Monkey** is a small vervet monkey, recognised at once by the pale blue band across its upper lip. From a distance it looks as though it had a blue moustache. This species is found mainly in Southern Guinea and the Cameroons.

The **Diana Monkey** is found in forests from Gambia to Liberia, in Ghana and on the Ivory Coast. This is one of the most elegant of all monkeys, both in colour and movement, so it was not named after the Roman goddess by chance. Its fur is black and white, boldly contrasted. There are two races and that from Ghana has a long, pointed, white beard, while the Gambian and Liberian race has a short, black beard. Old males of the Ghana race are coloured yellow or orange on the inside of the haunches and the lower abdomen, and this colouring is displayed to other males as a warning.

Hamlyn's Monkey inhabits the jungles of the Northern Congo and the banks of the Ituri river. Its most striking feature is its face which is dark in colour and divided by a white stripe running down over its nose. The hair on its head grows concentrically and the general appearance is owl-like. This resemblance to an owl is increased by nodding movements when the monkey is excited. It is not surprising that Dutch settlers called this monkey "owl head". The upper part of the body is greyish-green, the underparts, tail, arms and legs are black. Hamlyn's is one of the rarest monkeys in zoological gardens.

The **Hussar Monkey** is frequently kept in zoos. It differs from the true guenons in its appearance and way of life. It is pale brownish-red in colour with a pale face and conspicuously long front and hind legs. It lives in West Africa, not in jungles but on open savannahs. Although it is a long-tailed species, able to climb rocks and trees with ease, most of its life is spent on the ground. It is a fast and skilful runner. When a troop is moving it tends to march in some sort of formation, hence the name, Hussar.

Mangabeys are larger than the guenons. There are four species. They have conspicuous ischial callosities. The fingers are joined together; characteristically, they walk on all fours and carry their tails upright. Another conspicuous feature is their white eyelids.

The **Plain-headed Mangabey** is one of the West African monkeys most often kept

in zoos. It is smoky-grey in colour with a yellowish-brown face. The **Black,** or **Peaked Mangabey** is black and there is a long tufted point of hair on the crown of its head.

The Macaque monkeys are favourites in all zoological gardens. Not even the smallest zoos can get along without them and we find them even in circuses. They are hardy and breed readily in captivity. They form an important group because they are widely used for experimental purposes in research laboratories. They have been used to a very great extent in medical research as their body organs are very similar to human organs. They have been used to test the effectiveness of new drugs and intricate operations have been performed on them. In recent years, the macaques have been used in the production of antipolio vaccines. The researchers claim that the macaques have played an important part in saving human lives and in preserving human health.

Not so long ago, macaques were found in Europe. To-day, of course, there is only one species found in Europe, the Barbary Ape. It is found on the cliffs of Gibraltar and in Southern Spain. The other macaques live in Southern and Eastern Asia and are even found high up in the mountains of Tibet. They are medium-sized monkeys with a prominent but rounded muzzle. The prominent eye arches give them a permanent frown, particularly the males. The tail is shorter than in the guenons and many species have none at all. The macaques have very large ischial callosities and large cheek pouches. While they live mainly on vegetable food, they will take eggs or small mammals.

In the wild, the macaque lives in troops headed by an old male. Younger males

Hamlyn's Monkey

form their own troops once they are sexually mature because the leading male is too intolerant. As soon as young males are mature they bite still younger ones and drive them off. The female carries her young about with her on her abdomen for a long time. The gestation period is

Hussar Monkey

seven months and the young are not fully grown until they are 4½ years old.

The **Common Rhesus** is the best known of all the monkeys because of its long association with man. Vast numbers are used every year in medical research and, in more recent times, the rhesus has travelled in outer space.

The adult rhesus monkey is heavily built and will measure up to and over 2 feet in length, plus 12 inches of tail. The fur is grey with a tinge varying from yellow to red, the overall effect being yellowish-brown. The hind-legs are about the same length as the forelegs. The hair on its head points backwards.

India is the home of this universally known species. The northern boundaries of its habitat are formed by the Himalayas and it is found eastwards as far as South China. The rhesus is a very hardy breed and has been seen at heights of over 6,000 feet above sea level. Other species of macaque have been found as high as 12,000 feet.

Black Mangabey

The rhesus monkey lives in troops of about thirty animals or more, each troop being led by an old male. The leader is quarrelsome and intolerant towards other males, whom he drives away. Troops are found in forests or on rocky ground and appear to have no defined hunting area. The animals wander around, probing in the ground for seeds, bulbs, the shoots of young trees, or insects. They eat also spiders and other invertebrates. Although in some parts of India the rhesus is considered a sacred animal it is a pest in some others and can be a real problem in fields and plantations because of its monkey habit of selectiveness. The monkeys fill their cheek pouches to capacity then they pick and choose the best of whatever the field produces. In areas where they are considered sacred, these depredations are overlooked and the religious sects of the area will not allow the monkeys to be harmed. In such places they quickly lose their fear of man, so if a troop is chased away from one corner of a field it calmly proceeds with its depredations at the other end.

Many travellers have told of the tameness of rhesus monkeys in Indian towns. The following is an account by Johnson:

"As I walked through the streets an old macaque followed me from tree to tree. Suddenly it jumped to the ground, grabbed the turban off my head and disappeared. In that town, on the bank of the river, I lived in a large house owned by a wealthy Indian. The doors of the house were never firmly closed and monkeys often walked into the room and carried away bread and other things from the table in front of our eyes. Often I pretended to be asleep so that I could watch and enjoy their cleverness and cunning. Making fifteen feet leaps from house to house while carrying two young and a

loaf of bread and sugar was mere play to them."

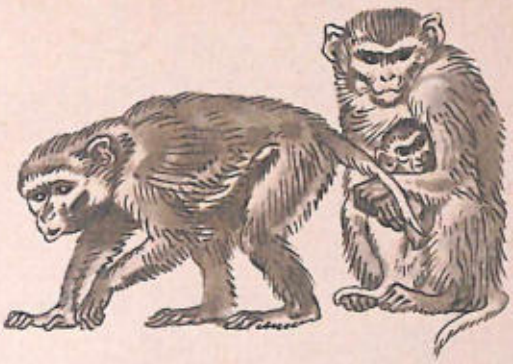
Further on, Johnson described how monkeys completely destroyed everything in a room where a feast had been prepared, throwing about all the dishes and the prepared food. A small dog which attacked them was picked up, carried to the top of a tree, and thrown to the ground.

Rhesus monkeys are extremely active and excitable. In the wild, pairs are always squabbling and the leader spends a lot of time settling disputes between them. In captivity they do not behave much better, particularly where large numbers are kept together. In zoos, rhesus monkeys are always mischievous and an escaped animal can create havoc wherever it goes. An animal let loose in a room will tear down curtains, chandeliers and mirrors, strip beds and litter the place with feathers. In Hamburg, a few years ago, a number of rhesus monkeys escaped from the zoo and entered flats from which they threw stones, vases, alarm clocks, books and other objects on the people below, until the police and the fire brigade arrived to catch them.

Although rhesus monkeys quickly fly into a rage they can be subdued if properly handled and can even be taught certain things. In circuses, for example, their "acts" are always among the greatest attractions. At one time, rhesus monkeys were dressed up and exhibited at fairs, where they played the organ or were used to pick out cards to tell the future.

In captivity, rhesus monkeys do well; they are easily fed and will thrive well on a mixture of cooked potatoes, various vegetables and fruit.

As a rule the rhesus has one young at a birth. The gestation period is 164 days and the young animal is not weaned until



Common Rhesus

it is about one year old. At the age of four years, it is sexually mature and at five it is fully grown, It may live to an age of twenty years.

The **Crab-eating Monkey** is often kept in zoological gardens. It is also known as the Java monkey. It differs from the rhesus in having a more prominent muzzle and the tail is the same length as its body. The hair on its head forms a lengthwise ridge, similar to a child's curl. It inhabits the Malayan Archipelago.

Troops of ten to twenty animals move about the jungles in the daytime, particularly in the area of swamps, rivers and lakes. It is the most water-loving of the macaques and the best swimmer. It has no fear of water at all. It can swim extremely well and its style resembles the fast crawl used by human beings in races. A whole troop of crab-eating macaques will swim across a river to escape danger, the mothers carrying their young on their backs as they swim.

Besides being a first-class swimmer, the crab-eating macaque is an excellent diver.

The zoologist, Blanford, has recorded how a captive macaque leaped from the deck of a ship and swam more than fifty yards underwater to escape its captors.

Crab-eating Monkey

The animals will hunt for food at a depth of twelve feet or more under the surface. They keep their eyes open all the time they are under water.

Besides eating the same food as the rhesus macaque, the crab-eater likes birds' eggs and young, and when close to the sea or mangrove swamps, it will eat crabs and even slugs and snails.

The **Lion-tailed Macaque** is generally similar to the rhesus and the crab-eater. It measures up to 3½ feet in length of which 10 to 15 inches are tail. At the end of its long tail it has a leonine tuft. Round its face it has a broad ruff of hair. The hairs on the crown of its head form a cap, often with a dividing line down the centre. This species also swims well. It is found in Southern Asia.

The German psychologist, Professor Schmidt, gives an interesting account of the behaviour of macaques in captivity in his book *Encounters with Animals*. Here is an excerpt from his chapter on the games that these animals play:

"The monkeys' games lasted non-stop for several hours. If there was a pause in their playful scuffling one of the monkeys would leap high into the air like a young kid and, at other times, they would catch their own tails and one would often bite its tail so hard that it would cry out in pain. What they liked best, however, was to splash about in the water and wash themselves. At other times, they splashed the water out of basins with their hands and observed the drops with interest. They also put their hands underwater, cupped them and lifted them into the air trying to hold water. They washed all eatable and uneatable objects, especially things like handkerchiefs and scarves. They rubbed the handkerchiefs in the water, then rinsed them, and, finally, hung them up to dry on the bars of their cage.

"One of the peculiar monkey games they enjoyed was beautifying themselves by putting on things, the males using beanstalks, strings and other articles. The female would put a scarf over her head and then promenade up and down the cage on her hind legs or start climbing the bars. Quite often two monkeys would stick a marmalade jar on their heads and, facing each other, perform various conjuring tricks. They loved noisy games too, such as carrying tins to a high perch and dropping them to the floor. Or, they would beat with spoons on an old saucepan as though it were a drum, or beat their milk bowls against stones."

The macaques hitherto described have a well developed tail. There are other macaques that have a very short tail. The **Barbary Ape** is the best known of the short-tailed macaques. Like the other species, the colour of its coat ranges from reddish-brown to yellowish-brown, but it has a stunted tail. It is the only European ape in existence, being found in Gibraltar and Southern Spain. It inhabits the rocky

forests of North West Africa. In Gibraltar, the Barbary apes are protected by law and have really become the pets of the British army there. Their population is kept healthy and up to strength by importations from North Africa.

The traveller, Posselt, tells of his encounter with these fortress apes:

"About two hundred yards from where I stood was the first battery aimed at Spain and, here, at a turn in the road, my attention was suddenly drawn by a sharp sound which at first I thought was a dog's bark. Then I discovered that the barking sounds were made by an animal about the size of a small dog which was running along the buttress of the gun battery. I stopped and noticed that it was a monkey which was probably keeping watch for its troop. At the end of the buttress wall two more monkeys were lying warming themselves in the sun. I approached slowly while the trio watched me closely. When I was one hundred yards away I stopped and saw the monkeys quieten down. The animals were obviously happy in the warm sun, hugging each other and rolling about on the wall. Every now and again, one would leap on to the gun, slip in the muzzle and come out at the other end where its companions waited for it."

In the wild state, the Barbary ape lives in troops led by a powerful male. They inhabit regions where the temperature often sinks well below freezing point, so they are very hardy and quickly become accustomed to northern climates. In the eighteenth century an attempt was made to introduce Barbary apes to Germany. The monkeys settled in well, bred successfully and survived the European winters for twenty years. Unfortunately they had all to be shot because a mad dog bit them and infected them with rabies.

Lion-tailed Macaque

The Barbary apes of Gibraltar were almost certainly introduced by man, although there is a legend that there is an undersea tunnel connecting the caves of the Rock with North Africa.

Barbary Ape

The Baboons are the largest representatives of the Cercopithecidae family and are easily recognised by their pronounced dog-like muzzles. They have powerful teeth, particularly the males who have tremendous canines, more like the canines of carnivores than monkeys. The small sunken eyes and heavy brows give the baboon an angry and frowning look. In some species the ischial callosities are very highly coloured. The tail is of medium length and the baboon carries it slanting upwards with the last third loosely dropping.

Of all monkeys, baboons move least in the trees. They prefer to walk on the ground on all fours with their palms and the soles of their feet on the ground. They rarely stand erect. When running they move like clumsy dogs, but with speed. They also climb well and although they look clumsy they are surefooted, even when they are leaping about rocks on a steep hillside. They feed on bulbs of many kinds as well as on the stems of plants, roots, insects and honey. They have a remarkable ability in finding water and can find it even where man has never looked for it, slowly but surely digging their way down to its source. The natives of South Africa exploit this ability and use tame baboons to find water for them.

Baboons are brave and often truculent, sometimes offering resistance even to man. When threatened, the animals display their strong canine teeth and the threat is usually sufficient to drive away even the strongest enemy. For this reason, they have very few predators. The leopard and the lion hunt them. The natives do so, using specially trained dogs.

The baboons played an important part in the mythology of the Ancient Egyptians and we find them depicted on the most ancient excavations. They are referred to as *anin* or *anan*, which means imitator. The Egyptians were particularly fond of breeding these monkeys and artists painted many aspects of their behaviour. Most frequently, they depicted a captive baboon amusing itself by skipping about and gesturing. The Egyptians revered the baboons as holy animals and embalmed the bodies after death. This is proved by the numerous mummified baboons preserved to this day.

The **Sacred Baboon** is typical of the family. The old male is easily recognised by his flesh-coloured face and ischial callosities. The fur is yellowish-brown and the male has a highly decorative ash-grey mantle of long, grey hairs on his head and shoulders. The tail tip has a tuft of longer hair. The female is not so striking and has a brownish coat. The new-born young resembles its parents only in its protruding muzzle. It clings to its mother's abdomen and its black fur contrasts sharply with the mother's brown.

This species inhabits rocky hillsides in Abyssinia, Somaliland and Southern Arabia. The powerful males of this species inspired the sculptors of Ancient Egypt to create giant sphinxes with baboon heads. In some areas, even to-day, the baboon is revered and many Abyssinian tribesmen wear head-dresses that imitate the animal's head.

Led by an old and powerful male, the sacred baboons live in troops numbering about twenty animals. The basic law of the troop is absolute obedience to and respect for the leader. Any female or younger male approaching the leader must greet him each time and this behaviour can be observed among captive animals in a zoo. The baboon greets its leader by

displaying its red buttocks to him and woe betide the animal that forgets to do so. The old male immediately attacks the forgetful one with his sharp teeth. He will do the same if another baboon attempts to take food he wants for himself. The leader will attack such an animal at once, open its mouth and forcibly remove all the food from its cheek pouches.

Where their habitat can maintain large numbers, troops will join together to form larger units, numbering from 150 to 300 animals. By joining forces in this way, the baboons are better able to defend themselves against their enemies, and no predator would dare attack a group of such a size. If a troop is threatened, 15 or 20 full-grown males prepare at once for defence. The sight of these powerful animals, standing more than three feet tall, and the display of teeth, more terrifying than those of the leopard, are usually enough to drive off any would-be attacker.

The baboons do not fear man at all and will drink from the same fountains as people. They draw away only on the sight of a man with a gun. Many travellers have, however, described cases where even a well-armed man has had to withdraw to allow the baboons to drink first.

When hunted, the retreating baboons will throw sticks at their pursuers. Dead or wounded baboons are carried off by their companions, where possible. Hagenbeck in his book, *About Animals and People,* described an incident that almost cost a baboon hunter his life. As the hunters were coaxing a monkey into a cage, through a trap-door, they were attacked by a large troop of baboons brought to the spot by the cries of other monkeys that had been caught.

Hanzelka and Zikmund observed this aggressiveness of baboons and described

Gelada

their experience in their book, *Africa, Imagined and Real,* as follows:

"We had hardly travelled a few miles from Garisa when a great troop of baboons ran across the road in front of us. Only a small group remained on the other side of the road, occasionally looking at our car. In the last minute, a big male with an armful of stones ran towards us. A few yards from the car he stopped, threw the stones at it and disappeared into the undergrowth. On the unbreakable glass of the windscreen there were now two star-shaped cracks."

Only young baboons are caught for zoological gardens as full-grown animals would never settle in captivity. To catch them, the hunters make use of the animals' greed and bait them with the titbits they like best. Sometimes they catch them with strong, leather lassoos.

The greatest enemy of the baboons is the leopard, for they are its favourite food. As soon as a leopard approaches a troop

the sentinel baboons give the alarm, but even a leopard would not dare to attack a full-grown male. Instead it stalks quietly towards a young animal and seizes it in a swift rush.

In captivity, young baboons are friendly and good tempered. They play a great deal and are active throughout the day. Their good manners and playfulness become less noticeable as they grow older, and at four years of age the tamest young become bad tempered and irritable. Even their keeper no longer dares enter their cage in case of being beaten.

The **Guinea Baboon** is greyish-brown to yellowish-brown in colour with dark face and dark ischial callosities. Its tail is half the length of its body.

The **Gelada** is a very hardy species that lives at a great height in the Abyssinian highlands. Its coat is dark brown and the long hair on its shoulders forms a kind of mantle. The tail ends in a tuft of stiff hairs. On their breast the geladas have a naked spot which swells during the mating season.

Quite different from the preceding species are the **Mandrills** which are among the largest of monkeys. They are dog-faced and have large, powerful teeth. Their stub of a tail is only 2 inches long. An adult male will weigh about 120 pounds. Mandrills have strikingly lined and wrinkled faces, the lines following the peculiar shape of the cheek bones. The body is stocky and powerful and the muscular arms enormously strong. The massive head of the males is impressive and apparently too big for the body. Females are much smaller than males.

Although they are forest animals, mandrills spend much of their lives on the ground. They live in small troops numbering from ten to thirty animals headed by a master male. Like the baboons, they feed mainly on fruit, grain, tree shoots and insects. The young, when small, are docile and playful but as they mature they become bad-tempered and aggressive, and dangerous even to man.

There are two members of this subgroup which are easily recognised.

The mandrill is conspicuous because of its vivid colouring, a characteristic which is unusual in mammals. It has a flaming red nose, blue, wrinkled cheeks and orange whiskers. The coat is dark brown with fine yellow spots. The ischial callosities are red and purple. The female is smaller and less brilliantly coloured, having blue cheeks, a black nose, and no whiskers. Mandrills are found in West Africa. They live in small family groups. The gestation period is 245 days. Besides vegetable food, the mandrill eats insects.

The **Drill** is smaller than the mandrill and less brightly coloured, its face being black. It, too, is a West African species. The drill is a powerful, aggressive monkey and a troop will put even the leopard to flight. In addition to fruit, leaves and fungi, drills eat worms, insects and small vertebrates.

The **Langurs** differ from the other members of the Cercopithecidae in several important characters. They have conspicuously slender bodies and their forelimbs are slightly longer than the hind limbs, while the thumb is either rudimentary, or completely missing.

Langurs live in the tree tops and feed mainly on leaves. As a result of eating such indigestible matter they have evolved

Langur

a highly specialised digestive system with a stomach like ruminants.

The **Langur,** or **Entellus Monkey,** is the most numerous representative of this group. It has a small, round head and its coat ranges in colour from silvery grey to brown. Its face, hands and feet are black. In India, where this species is found, it is considered a holy animal and many temples have been erected to it.

There is in India an interesting fable explaining why this monkey is considered holy and why its hands and feet are black. In the days of the giants, the langur freed a goddess who was being held prisoner by an evil god, but, monkey-like, he took time to steal a mango from the evil god's garden during the rescue. He carried off both goddess and mango: thus he earned the gratitude of the people because he had brought them an important fruit, the mango tree. This was the beginning of the adoration of the langur. But the evil god punished the langur for his theft by sentencing him to death by fire. The langur, however, thanks to his cunning, escaped from the circle of fire with only his hands and feet blackened by the flames.

Like all monkeys, langurs are great practical jokers despite their serious look. They will throw down fruits and dry branches at people from the trees. Like rhesus monkeys they will enter houses, railway stations and even trains, and a troop can do a great deal of damage in a very short time.

Langurs are very hardy monkeys and they are found in the Himalayas up to a height of 12,000 feet.

The **Capped Monkey,** which is related to the langur, is found in Assam. Its fur is grey above and white on the underside. The face is black and there is a long crest on its head.

Capped monkeys are large and powerful. They inhabit forested regions and live in troops numbering up to fifty animals. They feed mainly on leaves and fruit. Unfortunately, many of these monkeys are shot by poachers because great profits can be made out of them. In the stomach and intestines, and sometimes even in the bladders of the capped monkeys, there are calcareous formations up to the size of an

Capped Monkey

egg. The origin of these stones is still not clear, but they are reputed to have aphrodisiac properties. As a result they are in great demand and fetch high prices. Thus, a superstition similar to that concerning

Snub-nosed Monkey

rhinoceros horn has brought these interesting monkeys to the verge of extinction.

The **Snub-nosed Monkey,** or **Golden Monkey,** is as rare and little known as the preceding species. Its range extends from Burma to Saikang and up to Szechwan. It has long, fine, orange-yellow fur, the limbs and tail tip being lighter, and the head and haunches darker in colour. The body length of this species measures from 2 to 3 feet and the tail is longer still. The most striking characteristic of the species is its small, pointed, upturned nose.

The Tibetan snub-nosed monkeys are hardy animals and can live up to a height of 9,000 feet above sea level. They are well protected from the cold by their thick fur which is up to one foot in length. At one time the fine pelts of these monkeys had to be handed over to the Imperial palace.

Very little is known about the life of these monkeys in the wild, for they inhabit extremely inaccessible regions and keep mostly to the tops of trees where they are difficult to see. Their main habitat is thick bamboo forest in areas which are often snowbound in winter. Like all langurs, or leaf monkeys, they feed on the shoots of bushes and trees and on leaves and fruits. They rarely descend to the ground and when they do they walk like dogs with their tails upright. Their legs and arms are comparatively long, but their fingers are conspicuously short.

Because of the severity of the winters in their harsh mountain habitat, these monkeys make seasonal movements — down to the valleys before the onset of winter and back to the higher altitudes in spring.

The **Abyssinian Guereza** is the handsomest of the guereza sub group. This

species is notable for the fact that it has no thumb. Its fur is black and white. The black hairs on the head form a cap and the black face is framed by long, white hair. Long, white, silky hair grows also on its haunches, forming a kind of skirt. There is a tuft of white hairs on the tip of the tail.

Guerezas inhabit high mountain forests, living in troops of ten to twenty animals. Because of their handsome fur they are much hunted and have become almost extinct in many regions. Both natives and Europeans use the guereza's pelt for a variety of purposes and every year thousands, even tens of thousands, used to be killed. To-day the species is protected by law and poaching is severely punished.

The guereza is not often seen in zoological gardens because it is a difficult animal to keep in good health. It requires a continuous supply of fresh leaves in variety. It does not thrive on any other form of food and dies even when managed with the greatest care.

Abyssinian Guereza

If the Abyssinian guereza can be called the handsomest monkey of this group, then, surely, the **Proboscis Monkey** is the oddest looking. The mature male has a bulbous nose which is about three inches long and hangs over his mouth like a banana. It is an inconvenience to him because he has to use one hand to push it out of the way while he is using the other to place food in his mouth. Zoologists are still puzzled about the function of this exaggerated nose, but have recently discovered that it does serve as a kind of sound box (see the Howler monkeys). The monkey uses his nose to amplify the sound of his voice when he is proclaiming his occupation of territory. The females and young have much smaller noses, proportionately about the size of a man's, which are turned slightly upwards.

The proboscis monkey, like the guereza, is now a very rare animal. It is found in the jungles of Borneo (Kalimantan).

Proboscis Monkey

It is rarely seen in zoos because it feeds mainly on leaves and is, therefore, difficult to keep in captivity.

The proboscis monkey does not differ much from its relations in its way of life. There are several related species. They all live in small troops and spend most of their lives in the tops of great forest trees, where they will often rest sunbathing. They feed on palm leaves. Proboscis monkeys are quiet in disposition but can defend themselves ably when threatened.

APES

Family HYLOBATIDAE

Compared with the Cercopithecidae, the gibbons form a comparatively small group of species. Like the great apes they have long arms and no tail; unlike them they have the rough skin on the buttocks, known as ischial callosities. The hair of the arm grows from the shoulder downwards to the elbow; on the forearm it grows upwards from wrist to elbow. The gibbons are big-chested animals. Their forelimbs are longer than their hind limbs. They have no cheek pouches. Like the other great apes they have large brains and their intelligence is second only to that of man. Like the orang-utans they have a shorter spine with fewer thoracic and lumbar ribs. All gibbons are smaller than orang-utans, reaching a maximum weight of a little over 20 pounds.

Siamang

Gibbons are completely at home in the tree tops where their method of progression is to swing along, hand over hand, using their long fingers as hooks. They will run along horizontal branches with their arms aloft and their fingers in contact with the branch above. Swinging from branch to branch they can cover distances of more than thirty feet. When moving about in the tree tops they use their hind legs hardly at all. On the ground, the gibbon walks with the arms upheld, stepping on the whole sole of its foot. The arms are used for keeping ballance. When running the gibbon goes down on all fours. When walking erect its uncertain gait is like that of a small child. The gibbon can straighten its legs at the knee almost like a man, whereas the other apes, even orang-utans, always have their legs slightly bent at the knees when they stand upright. The orang-utans, however, seldom walk erect.

Neither gibbons nor orang-utans can swim and quickly drown if they fall in the water. In this they resemble man who has no innate ability to swim, and must learn to do so.

All other monkeys swim instinctively if thrown into the water. Gibbons, however, actually fear water and when they want to drink they dip their hands in, raise them and let the water drip through their fingers into their mouth. Or, they may lick their fingers. The gibbon, however, does not need a great deal of water as it feeds on juicy fruits and young shoots.

The home of the gibbon is the jungles of Malaya. They do not live in troops but in small family parties composed of a male with a female and several young. Such a family party will occupy an area of jungle of about 100 acres. The male warns other gibbons off his territory by vocal displays and sometimes by fighting. The gibbons sleep during the night, each member of the family seeking out a forked branch to which it clings firmly in sleep. At sunrise, the family awakes and goes out in search of food.

The gestation period in gibbons is seven months. The mother carries her newborn young on her side. The young grow slowly and do not reach full size until they are from six to eight years old. That is why there are several young of varying ages in a family party.

The **Siamang** is the largest of the gibbons. Its most notable feature is the huge reddish-brown vocal sac on the throat, which is present in both male and female. Another feature is that the second and third toes of the hind feet are joined together by a web of skin.

The **Lar Gibbon,** also known as the

White-handed Gibbon

White-handed Gibbon, is found in Burma, Siam and the Sunda Isles. In this species, there is great variation in the colour of the fur which is dark, or light, according to the local environment. The face of the lar gibbon is framed by a distinctive white line.

The systematic arrangement of gibbons is very complicated and it is often doubtful whether certain types are actual species or merely geographical races. Besides the lar gibbon, modern zoologists now recognise the **Black Gibbon,** the **Silver Gibbon** and the **Hoolock,** the **Dwarf Gibbon** and the **Dark-handed Gibbon.**

During recent years, considerable success has been achieved in breeding gibbons in zoological gardens. At least three species have bred successfully and this has greatly increased our knowledge. In captivity, gibbons are most exacting animals.

Black Gibbon

Hoolock Gibbon

They must be kept in scrupulously clean conditions and are hypersensitive to any change in diet. They live on plant food, particularly fruit, and are fond of salads. They lose condition if their food is deficient in vitamins. It has now been shown that gibbons do not require great warmth to thrive. In France and England, for instance, it is possible to keep them out of doors all the year round.

Most gibbons are very affectionate and if brought to the zoo as young animals they soon become tame and attach themselves to their keeper. Among themselves, however, they can be intolerant, especially the mature males, who will attack and bite severely any monkey approaching them. In the Prague zoo, a male gibbon wounded several visitors who climbed over the barricade and tried to take him by the arm. The gibbon's long arm is slender but powerful, so powerful that a gibbon once dragged a full-grown man against the bars of its cage and tore off a large piece of flesh in one quick bite.

Recently, a case was reported from America where a siamang killed its keeper.

Nevertheless, it can hardly be said that gibbons are savagely aggressive. What they do have is a strong sense of territory and anyone presuming to enter this territory has to be prepared for aggressive display. Because it is so slim the gibbon's strength is usually underrated. What has been said of the other large monkeys (baboons, guenons and mangabeys) applies also to gibbons; as soon as they are fully grown they must be carefully handled because they consider man as a member of their troop and thus try to gain ascendancy over him. If a man has to face, empty-handed, an ape fighting for supremacy over him, his chances of coming out victorious are very slight indeed.

III 1. *Grey Gibbon* 2. *Black Ape* 3. *Sacred Baboon* 4. *Mandrill* 5. *Guinea Baboon* 6.ª *Drill* 7. *Orang-utan*

Family PONGINAE

The Great Apes are the largest living monkeys. Many chimpanzees and orang-utans grow to the weight of a man, while the gorilla is actually heavier. In this group, the hair of the body is much sparser than in the gibbons and only in certain species do we find a remnant of the ischial callosities which are like small corns.

On the ground these big apes walk on all fours, but they do not step on the whole sole of the foot like other monkeys; like man they tread only on the outer edge. On the inner side they lean on the thumb, which is bigger than that of man, but, like his, can be opposed to the other fingers. When walking they do not touch the ground with the palm of the hand. Only young animals do this, but they soon learn to walk like their elders, that is on the back of the hand, exactly on the joint of the fingers where hard callosities form. While this group has many characteristics in common with man he has not descended from them but from the same ancestral type.

The ponginae surpass all other animals in mental ability, because, next to man, their brain is the most highly developed. However, even this highly developed ape brain cannot be compared with man's. This is easily seen if we examine the volume of the skull cavity, the so-called brain cavity. The volume of the brain cavity of a chimpanzee is 25 cubic inches, that of an orang-utan is 27 cubic inches, that of a gorilla 31 cubic inches, while the volume of the human brain cavity is 91 cubic inches.

The **Orang-utan** is the only Asian anthropoid, and inhabits the jungles on the islands of Borneo and Sumatra. Its name is Malayan and means "man of the woods".

A male orang-utan stands up to 5 feet tall, the female is smaller, reaching a height of nearly 4 feet. Full-grown animals weigh from 155 to 175 pounds, the males being heavier. They are very striking animals with their long rust-red hair and their exceptionally long arms which reach almost to the ground, even when the animal is standing erect. The head is deeply set between the shoulders, which are hunched up to the level of the small ears so that at first glance the animal appears to have no neck at all. Females and young have a rather round head and a remarkably human look, but mature males have bluish-red cheek pouches and a throat pouch like a goitre. The throat pouch has a capacity of up to $1^1/_4$ gallons. For a long time nobody knew what this throat pouch was for, but careful observation has discovered that the orang-utan can inflate it with air, and thereafter use it in vocal display. Although the sound made is weak, it carries far in the silent jungle and is an announcement that the caller is holding territory.

By nature the orang-utan is much quieter than the other anthropoids. Its movements are slow and deliberate. In trees its movements resemble those of the gibbons and it walks upon the branches in the same sure-footed way, only with more deliberation.

The males are solitary animals and live apart from the females. The females keep to the tree tops with their young, which become sexually mature at the age of eight years old, but not fully grown for another year or two. The potential life span is long, fifty to sixty years according to reliable reports.

A habit common to all anthropoids is that of building a nest of branches in a tree top at dusk. This is lined with leaves and twigs. Captive apes display this same urge and build themselves a new nest every evening of blankets or whatever is available, before going to sleep.

Orang-utans feed mostly on fruit and young shoots but also eat insects, eggs and small mammals. They are very selective in their feeding and destroy more than they actually eat.

The gestation period is about eight months.

The orang-utan is now a rare animal and man must bear the entire responsibility for this. W. Ullrich of the Dresden Zoo has written:

"Even in Sumatra, the orang-utan will soon be exterminated. In 1922/23, the plantation workers were hit by a great economic crisis. Plantation owners and their employees started looking for other jobs and either returned to Europe, or started hunting animals. Big game, particularly orang-utans, now had a bad time. Hunters captured the young orang-utans by shooting the mothers. Often they felled many trees, making a clearing round the tree in which the orang-utan was sitting so that she could not escape. Then they made a fire and felled the tree. In this way, mother and young were often wounded and even killed. Only at the last moment did the government pass a law to protect the orang-utans, but the senseless slaughter continued. While the white man stopped hunting, the local tribesmen continued to do so, secretly, using narcotics to drug the animals. There are always people prepared to pay the local men well so that the orang-utan is still hunted and smuggled out of its native land. The animals are transported secretly in small cases and very badly fed. Out of one shipment of apes that reached Rotterdam, only eight were alive on arrival and in another shipment of thirty-two only five remained alive."

From this it is quite clear that if strict regulations are not introduced to protect them these rare anthropoids will soon be completely exterminated. It is estimated that fewer than 5,000 orang-utans exist to-day.

In captivity young orang-utans are very affectionate, but they require the same care as babies. When fully-grown they are always surly and spend the entire day hunched up in a corner of their cage. Many of them never get used to captivity, refuse food and soon die. Nevertheless, in modern scientifically directed zoos, the animals have bred successfully and, thus, the first step has been taken in the preservation of the species.

Among the best-known anthropoids, and the most numerous, is the **Chimpanzee,** which is mentioned in records as far back as the time of the ancient Carthaginians. The male chimpanzee is slightly bigger than the orang-utan, reaching a height of 5½ feet. The female stands about 4½ feet tall. A full grown animal weighs from 110 to 165 pounds. The chimpanzee's coat is black and the face, hands and feet flesh-coloured, except in some races in which they are also black. In old age, the face becomes covered with freckles which are liable to join together to form larger black spots.

Chimpanzees inhabit the equatorial jungles of Africa. Unlike the orang-utans they are not strictly arboreal and do not have such long arms. Although they spend much time on the ground, moving easily and freely, they will not cross wide tree-

less areas. Large, open spaces, therefore, bar their movements. Like the other anthropoids, the chimpanzee cannot swim and drowns if it falls in the water.

In the wild state, chimpanzees live in small troops, numbering four to fourteen animals. An old, strong male leads the troop, but there are often other strong males in it. Observation confirms that the leading male does not play the role of tyrant among his followers and the relationships between males, and between males and females, are much more friendly and stable than in baboons. Males will even pick dandruff and dirt from each other's coat. Even during the mating season, males have never been observed fighting over females. This does not mean, however, that the leading male does not know how to maintain his authority. If an adult member of the troop ignores its code of behaviour, he is immediately punished by the stronger male. The young, however, are allowed to do anything they like.

A superficial observer might well believe that fighting and quarrelling are the order of the day among chimpanzees. In fact, this is not so. Chimpanzees give voice whenever they are excited about anything and if two troops meet there is uproar. The males beat upon tree trunks loudly, while the young animals scream and run about, but the uproar has nothing to do with fighting or aggressiveness. It is no more than an expression of excited pleasure. When real trouble occurs, it is usually dealt with only by gestures.

Although chimpanzees can utter a great variety of sounds, their calls can never be compared with human speech. The gestures and calls do have meaning in so far as they express a mood, but that is all. The basic difference between the calls of a chimpanzee and human speech lies in the fact that the chimpanzee is not mentally capable of expressing anything even though its gestures are understood by other chimpanzees and human observers. When a chimpanzee sees an enemy it utters a loud cry of alarm. When surprised by an enemy it will run away silently without warning the other members of the troop. The animal's call of greeting is hoo-hoo-hoo-hoo. Gestures are varied and eloquent — a female begging food from a male extends pleading hands to him. One expression of friendship is the reciprocal embrace.

There are many accounts of the chimpanzee's life in the wild but these are often distorted. The English zoologist, Jane Goodall, however, studied them at first hand and spent many months in the jungle moving among them. By her quiet behaviour, she gained their confidence until they ceased to take notice of her.

Chimpanzee

Some of them even began to visit her where they were always given some titbit, so the first thing she was able to discredit were the hunters' tales describing the chimpanzee as an aggressive and dangerous ape. To make her field study easier she gave every chimpanzee a name.

Jane Goodall discovered that during rain the chimpanzees sat in their nests hunched forward with their heads bent over their knees, waiting for the rain to stop. She never at any time saw any of them attempting to make a shelter or take advantage of a natural one. She found that in the rainy season the animals tended to go to bed earlier and rise later, and that during the day they often made themselves a day nest in a tree rather than lie on the cold wet ground.

Here are some of her other observations:

"Generally speaking, chimpanzees become more active during the rains and often for no apparent reason a male will break into a run, slapping the ground or hitting out at a low branch as he passes. When a large group is present this behaviour may develop into a display which I have called the 'rain dance'. I saw this on four occasions, always about midday and always on similar terrain. In every instance it followed the same pattern but the duration varied from fifteen to thirty minutes. It did not always take place in the rain, but rain was falling hard the first time I saw it. Females and juveniles climbed into nearby trees to watch this display.

"Rain seems to have more effect on some chimpanzees than on others. Goliath, in particular, often got very excited at the start of a rainstorm . . . David Greybeard is inclined to become truculent . . . once he stood upright in front of me hooting loudly with one arm raised above his head. He then faced about, hitting a tree, then a box, and finally me.

"In the wild the chimpanzee has definite carnivorous tendencies. It has always been suspected by scientists that wild chimpanzees might occasionally eat a small lizard or rodent, but no one thought that they might kill fairly large animals. I saw monkeys eaten on four occasions and twice found bits of bone in chimpanzee droppings. I once saw a young bush buck eaten and another time a young bush pig. I saw chimpanzees eating meat several times before I actually saw them attack and kill a young Colobus monkey.

"A young chimpanzee killed the colobus monkey. Five other chimpanzees then climbed up beside it, including a mature male. Because an adolescent had made the kill, the carcass was torn up and shared among the group with no fighting or quarrelling. At other times, however, when a prey is in possession of a mature male there is no such sharing. Raw meat is however only an occasional supplement to the chimpanzee's main diet, which is vegetarian. I have collected different

Chimpanzee

types of vegetable food eaten by chimpanzees, half of it consisted of fruit, one-quarter of leaves and the remainder of seeds, blossoms, stems and bark. In addition to this, the chimpanzees sometimes feed on insects, including termites and ants and they will use a twig, or root, to fish out termites. The termites bite the root, or twig, and are gently withdrawn while hanging on. Some chimpanzees will break off a twig and carry it with them while searching for a termite hill to fish in. This habit is probably learned by imitation and can therefore be regarded as a crude and primitive culture."

The author of this interesting observation paid much attention to the breeding of chimpanzees in the wild and confirmed what had been discovered from captive animals. The gestation period is 253 days. Baby chimpanzees weigh from 4 pounds to 5 pounds at birth. The baby is able to hang on to its mother's abdomen with hands and feet. She cares for her little one for a period of three years and the young animal will follow her for a period of up to five years, by which time it is building its own sleeping nest. The mother often rocks her baby and covers it with her hand when it is asleep. Puberty is reached at the age of eight years. Females are then sexually mature. Males mature later at ten to twelve years of age.

Captive chimpanzees will live for forty or fifty years if well cared for, but they must be kept away from other monkeys and people. They have a tendency to catch certain human diseases such as influenza, pneumonia and tuberculosis. Great mistakes used to be made with their feeding. They require especially vitamins B and C and do best on a diet of vegetables, fruit and rice.

Gorilla

A sick chimpanzee makes a good patient. He will extend his hand to his keeper and show him the place that hurts while begging for help with his eyes. The animal bears patiently with injections and will swallow bitter medicine without complaint.

The **Gorilla** is the greatest ape alive to-day. In 1964, the existing population was estimated at between 6,000 and 10,000.

Zoologists divide gorillas into two geographical races: the **Coast Gorilla** of West Africa, which inhabits the region between the Niger and Congo rivers, and the **Mountain Gorilla** of Central Africa, which is found only in the high volcanic mountain ranges of Lake Tanganyika and Lake Albert. Mountain gorillas have a much thicker coat than the Coast gorillas. They are much rarer and the strictest protection has been necessary to ensure their survival.

The habitat of the mountain gorilla is

far from being the kind of tropical jungle we associate with these animals. This species lives at a height between 8,500 feet and 14,000 feet, in a region of high rainfall and of violent storms often accompanied by hail. In these mountain jungles, the temperature can sink very low and there is sometimes frost. In addition fogs are frequent and the environment is far from pleasant for human beings inhabiting this part of the tropics.

The coast gorilla, on the other hand, is found at sea level in jungles which have a tropical climate.

The gorilla, as has been said, is the largest living ape. The male stands 6 feet tall, but cases have been recorded of animals up to 6½ feet tall. Females are always smaller and walk upright. They never reach a height of more than 5 feet. The weight of a full grown male varies between 3 and 4 hundredweight, but a captive male in the St. Louis Zoo in the U.S.A., reached a weight of 7 hundredweight. Females weigh between 150 and 240 pounds.

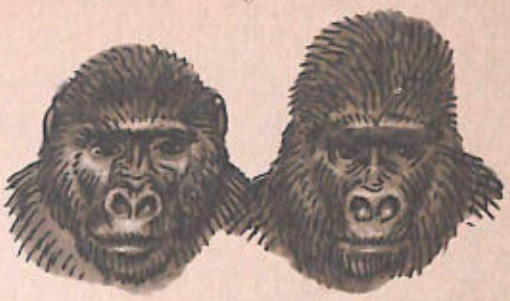
A full grown male gorilla, with his gigantic arm muscles and chest, is an awe inspiring animal. His whole appearance indicates immense strength. In the old and even in some of the latest travel books, we find the most terrifying descriptions of this great ape and he has been credited with abducting women and killing men with a single blow on the head. Recent observations by G.B. Schaller have banished most of these terrible hunting stories to the realm of fairy tales. Schaller's account is the best study of gorillas to date and was published in 1963 under the title *The Year of the Gorilla*. Schaller set up camp in the thick mountain jungles and his research required much time and patience before the gorillas accepted him and allowed him to approach within a few yards.

Gorillas, like most monkeys, live in troops. The average size of the gorilla troop is seventeen members but it can number up to thirty. The troop inhabits a territory covering 15 to 25 miles. Within this territory they make daily journeys of a quarter or half a mile but they may travel as far as three miles. Movement depends largely on the weather. During the days of fog, or heavy rain, the gorillas sit in their nests motionless, allowing the water to pour down their coats in torrents. When the sun shines, the whole troop moves to a clearing or other sunny place, where they can bask in the heat until the sweat pours from them in rivulets. All gorillas love the sunshine.

The troop leader is always a powerful male with a silvery grey back. Like the leader of a chimpanzee troop, the leading gorilla tolerates other males among his followers. Even territorial defence is not based on fighting. When individual gorillas meet they do not fight each other. On the contrary, they often pair off and wander away together. Of course, the leader of the troop still requires to be treated with due respect by his followers and if an old male leader encounters a younger, or older, gorilla on a narrow path, the subordinate animal must make way for him. Usually a look is enough but if the subsidiary animal hesitates it is pushed aside with a blow from the arm or chest. Old males will allow young animals to romp all over them, pull their hair, or sit on their backs while they walk. Schaller noted that only when a young animal hit an old gorilla on the face did he look crossly at it and this was enough to send the little one running to his mother.

Gorillas behave much more quietly than chimpanzees, one might even say they are more taciturn. Friendship between two individuals, as it exists among chimpanzees, is unknown among them. The chimpanzee, even when fully grown, takes every opportunity to play and romp with the young. Gorillas, on the other hand, lose all their playfulness once they have reached the age of six years and from then on they avoid the company of the young. The young animals play together, mainly during the afternoon siesta when the older gorillas are sitting quietly about, or dozing. During this period, the young gorillas amuse themselves by chasing each other up and down trees. The mothers, of course, take the greatest interest in their young, treat them very gently and take them in their arms and pet them. Their behaviour, however, is always very quiet, with something of human dignity about it.

All movements of a gorilla troop are directed by the leader. Like the chimpanzees, they can express their moods — reactions to an enemy, or fright, or the signal for flight. Zoologists now know twenty-two different calls which gorillas use on specific occasions and to these must be added many gestures and much mimicry. The best known of these expressive gestures is the imposing dance of the male, which expresses his supremacy over the other members of the troop and keeps at bay potential enemies, possibly including man. The dance begins with a cry which is interrupted by the male putting a leaf between his lips, then he stands erect on his hind legs and beats his chest with his fists. Finally he drops to all fours and runs quickly in the direction of the enemy, tearing up grass, breaking off branches and throwing them



Heads of Gorilla gorilla and Gorilla beringei

about before beating the ground with his palms. Hunters witnessing this dance usually lose their nerve and shoot the gorilla.

Schaller witnessed several of these attacks which are only aimed at frightening the enemy away. The male always stops at a distance of several yards and then runs aside, but the situation changes if the man starts to run away. To run away is to provoke an attack and the gorilla usually catches up with the man whom he will bite in the leg or arm before breaking off the attack. Such victims are a cause of mirth in their village because experienced members of the tribe know that if a man stands quietly where he is the gorilla will never attack him. One victim in particular was pointed out to Schaller by the natives. In his case, the gorilla had torn off a considerable piece of gluteal muscle with his canine teeth so that for a long time the man was unable to sit down. But there is no record of a gorilla ever having killed anybody after biting him. On the contrary, in one recorded case, females gathered round a male that had been shot and allowed themselves to be clubbed rather than put up any resistance.

From all this we see that the gorilla is a peace-loving animal and that the hunting stories which have turned him

into a demon of the forest are baseless fables.

Of course, this does not mean that we should underestimate the strength of a gorilla, especially a male. If a male finds himself in a tight corner he is certainly well able to defend himself and a man is a mere toy in a conflict with such an animal.

Daily observation of gorillas brought to light another interesting piece of behaviour. Before attacking a rival, the gorilla openly threatens him and he expresses this threat by staring into the other's eyes, frowning and wrinkling his forehead and uttering low growls. This entire threat display can be cut short if the person threatened merely turns his head away. In the language of the gorilla this act means "I have peaceful intentions". It is interesting to note that when two gorillas meet in captivity, they first turn their heads aside and then approach each other. From the human standpoint this expression of submission is similar to human greeting. It is a kind of obeisance, a bowing of the head as it were. A still higher degree of subordination is expressed by a young gorilla lying on her belly before the male, with her arms and legs folded under her and only her back exposed.

From this we see how some gestures in social contact are common to apes and men, which surely indicates a common ancestry. This is evident from other studies. For example, blood groupings, and the other properties of blood, are the same in apes as in man. Blood tests have shown that human blood is closest to that of the chimpanzees, then the gorilla and, finally, the orang-utan.

Examination of gorilla droppings and direct observations have shown that it is strictly vegetarian. The usual foods are the leaves and shoots of bushes and trees, bulbs, bark and some roots.

According to Sabatera Pi and De Lassaletta: "the natural environment of the coast gorilla is tropical jungle, but the considerable increase of the native population (Spanish Guinea) in recent years has resulted in the gorillas changing their territory. In many places they adapted themselves to the new conditions and showed great interest in the local plantations of bananas, cassavas, sugar cane and cocoa. It is a considerable problem for the authorities, for the gorillas have an exceptional voracity." These authors believe that the gorillas would normally find sufficient food in the jungle, but as living space is becoming more and more restricted and continuously deteriorating, their invasion of the plantations is the natural result of these conditions.

These authors definitely state that these gorillas live on the ground and that only some young males and females climb trees after fruit. Young gorillas, in fact, will climb fruit-bearing trees and throw the fruit down to older animals.

Gestation in the gorilla lasts eight and a half months, which is only a little short of the duration of human pregnancy but longer than that of the chimpanzee or orang-utan. The young gorilla at birth is much smaller than the human baby and weighs only from one pound to one and a quarter pounds. In the early days it hangs on to the hair of the mother's abdomen. The mother takes very good care of it, licking it and holding it in her arms. Development of the young is twice as fast as in man and at the age of two and a half months, the baby gorilla is able to feed on leaves. At four and a half months, it is able to run about and at the

age of seven months can climb trees. Suckling, however, continues up to the age of one and a half years old. The female produces one young every three or four years.

Because of its great strength, the gorilla has no important enemies apart from man, although leopards sometimes kill young ones. Gorillas pay little attention to other animals and show no interest in them.

ORDER: EDENTATA

The Edentates still in existence form only a small order of mammals; they are almost all of small size and not at all similar in appearance. Compare, for example, the armadillo with its armour-plating and the Hairy Sloth, or the Ant-eater, with its long muzzle. If we wish to understand this relationship, we must go very far back in the earth's history to the Tertiary era when far more numerous species of Edentata inhabited South America. The modern types must be regarded as the last remnants of this large group. The prehistoric Edentata were giants. For example, the Giant Sloth was as big as the modern elephant but had much longer hind legs. The extinct armadillo was such a gigantic animal that man could build a hut from its armour. Another Edentata, Grypotherium, was as big as a cow and died in recent times, some thousands of years ago. In the extinct Edentata, we can observe all the transitions between them and present-day species which are only distantly related.

The word *Edentate* does not really describe this group of animals very well, for only the ant-eaters are completely toothless, while the armadillos are well supplied, the giant species having up to one hundred and four teeth which is the greatest number known in any animal. The sloths have twenty teeth, so they too, are certainly far from toothless.

The common characteristic of these species is the arrangement of their pectoral and dorsal vertebrae. This special jointing is scientifically known as xenarthral. These jointed protuberances, which originated from the ossification of the cervical vertebrae, greatly strengthened the spinal column. For present-day Edentates, this is no longer important, but it was vital for their gigantic ancestors whose spinal columns had to carry a weight of many hundreds of pounds.

The young of the Edentata are well developed at birth. In the ant-eaters, the embryo develops in a special way; the ovum divides into eight or nine rings and each ring develops into a single young. A similar development of the embryo takes place only with the lower orders of animals such as certain species of insects. In other mammals, only a given number of ova can produce a given number of young. The order of the Edentata is divided into three special sub-orders:

SLOTHS

Family BRADYPODIDAE

The sloths are perfectly adapted for life in the trees and are easily distinguished from all other members of the order. They have a round monkey-like face with ears almost hidden in their rough, crisp hair. The stump of a tail is also hidden by the hair. Sloths always hang upside down with all four paws grasping a branch. This position has influenced the direction in which their hair grows, which is from the abdomen up to the back and not from the back down to the abdomen. The hair of the limbs grows in the same way; thus, the sloth which spends its life hanging upside down has reversed hair to shed rain.

Another feature of the sloth's hair is its colour, which is green and therefore provides excellent camouflage. This colouring is not due to pigment but to green algae which grow and live in the hollow, or grooved, hairs. Similar algae grow on the trees in which the sloths live. In a zoo the animal soon loses its colour and becomes yellowish-brown, or grey, because the humidity is not high enough for the algae to survive. In addition to algae, the sloth's hair provides accommodation for a species of moth, related to the clothes' moths. In addition to all these, a species of scarab beetle lives in the sloth's rectum.

As the name implies, sloths are sluggish creatures, but despite this some of them can cover five miles in a day in the tree tops. On the ground they are completely helpless.

Indians hunt the sloth with poisoned arrows but it is not easy to locate as it sleeps by day high up in the thickest foliage. Apart from man, it has only one serious enemy, the Harpy eagle, whose main food consists of sloths and monkeys. The sloth when attacked is unable to defend itself and the eagle soon kills it with its powerful talons. Once a sloth has eaten all the leaves in one tree, it must come to earth to move to another and then it may be attacked by ground predators, including the puma and the jaguar.

The sloth can swim well and has even been known to cross wide rivers, but it is not known why it does so.

Sloths are nocturnal animals as their large eyes indicate. The eyes have no pupils, or rather the pupils are no bigger than pinpoints. Their sense of smell is imperfectly developed and is therefore of little use to them. Their hearing, however, is very highly developed and sloths, like bats, can hear sounds too high-pitched for the human ear. Experiment has shown that the sloth can emit sounds which are inaudible to the human ear, which explains why until recently they were thought to be dumb. In fact, the animals make contact with each other by voice.

The sloth and other Edentates have an unstable body temperature, which wavers between 27—35° C. The temperature rises and falls even during the day. When there is a great change of air temperature the sloths fall into a lethargy, similar to hibernation.

The **Two-toed Sloth** is the commonest species and is most numerous in Brazil, Guiana and Surinam. It reaches a length of 27½ inches. It is recognised by the two long claws on its front paws and the three on its hind paws. This is the species most commonly seen in zoological gardens, where it has bred successfully. For

Two-toed Sloth

Three-toed Sloth

successful breeding in captivity, a sufficient quantity of the right food is necessary and in zoos they are fed hard-boiled eggs, radishes, kohl-rabi, salad, various fruit preserves, fresh pears, apples, cherries and plums.

The sloths in captivity are not much of an attraction because they spend all day in a corner of their cage and stir only when food is placed beside them. Otherwise, like the wild animals, they are strictly nocturnal, which means that they are never seen by visitors. Because of their limited mental abilities, they cannot recognise their own keeper and never get excited when he enters their cage with food. In time, however, they become accustomed to the presence of human beings.

The two-toed sloth is often brought to Europe by animal dealers. It is not an easy animal to capture because it is difficult to find. The hunter has then to climb to the tops of the highest trees and only the Indians can be persuaded to do this. The sloth has then to be torn away from its clawhold and the hunter does not manage this without receiving some deep scratches.

The Indians also hunt the sloth for food, using poisoned arrows which they shoot from a blow-pipe. Sloths are, however, resistant even to the Indian poison, curare, which is so potent that a mere scratch will poison a jaguar in a few minutes. The sloth can live for fifteen minutes after being struck.

The **Three-toed Sloth** is much more rarely seen in captivity. It is smaller than the previous species, reaching a length of only 19½ inches. It has three claws on both fore and hind feet. It has a smaller head than the two-toed sloth and its mouth slants obliquely. Its limbs are shorter. This species is found in the forests of Central and South America. The natives call it *aye*, after its call. The three-toed sloth does not thrive in captivity as well as the two-toed and even with the best care it usually dies after a short time. This may be because of the lack of some necessary item in its diet.

ANT-EATERS

Family MYRMECOPHAGIDAE

The **Great Ant-eater** is the largest living Edentate, measuring 6 feet from the tip of its nose to the tip of its tail and weighing up to 100 pounds. It inhabits grasslands, semi-desert, and open forest areas of Guatemala, Paraguay and the Argentine. The colour of the body hair is mostly grey-brown but there is a black stripe running from the neck and over the shoulders which is edged with white.

The ant-eater has a long, bushy tail which it curls over its body during sleep when it is coiled into a ball.

The most striking feature about the ant-eater is its elongated narrow head and conspicuously small mouth. It cannot open its jaws because they are firmly joined together. The lower jaws are simple structures, formed by two small bones like sticks which are firmly joined to the skull by skin and ligament. The mouth is no more than a small orifice out of which the animal sticks its long, worm-like tongue. The tongue can be protruded for 19 inches. It is operated by a strong muscle fastened down to the breast bone, and is kept constantly wet and sticky by the secretion from the salivary glands. The tongue is the only means by which the ant-eater can collect its food. It has no teeth, and as there are none in the embryo, it can be safely assumed that its ancestors were toothless too.

On its forefeet, the ant-eater has strong, sharp claws which are turned upwards so that the animal walks on its knuckles. As a result, the claws never become blunted. These strong claws are used for digging up termite heaps. When a heap is broken into, the angry insects swarm to the attack and are caught on the ant-eather's sticky tongue. As soon as the tongue is well covered with termites, the ant-eater draws it in and thus it feeds, repeating the process again and again. The ant-eater eats with its eyes closed to protect them against the termites. The skin of the eyelids is so thick that the termite's mandibles cannot bite through it. The nostrils and ears are also protected by thick, hairy skin. After such a meal, the ant-eater bathes to clear the termites from its body. It swims very well and is fond of water.

But how does the ant-eater chew its food when it has no teeth? In fact, the food is crushed in the stomach, not in the mouth, and the stomach is equipped with special muscles for this purpose, like the gizzard of a bird. By muscular contraction the walls of the stomach rub together like mill-stones, and the ants soon become a soft, easily digested pulp.

The ant-eater is a diurnal animal. It moves about slowly over the pampas with a rolling gait, sniffing the ground in search of ants at every step, guided in its hunting mainly by its sense of smell.

Although it is neither dangerous nor destructive to his interests, man nevertheless persecutes the ant-eater and it is quickly becoming a rare animal. When in danger, it runs ponderously and a man can easily catch up with it. The natives hunt it for its meat and for its decorative skin. If a man corners an ant-eater he

Great Ant-eater

must be very careful how he approaches it for it can inflict serious wounds with its strong claws.

The well-known traveller, Bates, tells of such an incident as follows: "When I could not get used to eating salted fish and could no longer even look at the eternal rice soup and fried bananas, hunters recommended me to try the meat of the ant-eater. I found a hunter who knew of the whereabouts of an ant-eater and he told me that the ant-eater had just killed his best dog. I hurried to the spot and found that the dog was not yet dead but severely wounded."

Kapler, who also travelled extensively in South America, describes another incident thus: "The manager of a plantation encountered an ant-eater and thought that he would kill it with a long dagger; however, he only wounded it slightly and the animal turned upon him, embraced him and held him so firmly that he could not move at all. He shouted for help for a whole hour before some people came to him. Only then did the ant-eater let go of the man and run away. The plantation manager was in such a state that he had to be taken to hospital where he remained for several months."

Tamandua

Very little is known about the breeding of the ant-eater. The female produces one young and looks after it for a whole year. With its claws the young animal clings to the thick hair of its mother's back. When it wishes to suckle, it moves down to the teats by way of the mother's tail. Having suckled, it climbs back up her tail on to her back again.

An ant-eater in captivity presents considerable problems. It is naturally impossible to find ants in sufficient quantities for it, so it is given specially prepared food composed of oatmeal, mincemeat, eggs, grated carrots and ant larvae. The ant-eater gathers this pap from a bowl with its long tongue. Animals fed on this pap have bred successfully in captivity. Dealers in wild animals do not seem to know about this mixture because most ant-eaters still arrive in Europe in an emaciated condition and cannot be saved even with the best of care.

The **Tamandua** is smaller than the Great Ant-eater and has four digits on its forefeet (there is a fifth which is much reduced), and five on its hind feet. It is about one yard long, half this length being tail. Its head is less elongated than the giant ant-eater's.

The tamandua is partly arboreal, and with its long, curved claws and prehensile tail is able to move with ease in the tree tops. In some regions, these ant-eaters are all-over dirty yellow in colour; in others they are bi-coloured. A dark stripe runs from the neck along the sides of the body to the haunches. This pattern is found in both types. The tamandua is found in South America but is more

widely distributed than the Great ant-eater and has been recorded from Mexico to Peru.

For its size the tamandua is exceptionally strong. Standing on its hind legs, supported by its tail, it can with a few blows of its fore claws tear its way into a nest of tree termites. With its dexterous tongue it probes into the galleries and gathers termites by the thousand. As in the ant-eater, the tongue is sticky. More than one pound of termites has been found in a tamandua's stomach. A man using a sharp axe would be hard put to it to break into such a nest. When defending itself the tamandua is capable of tearing a man's arm to the bone with one sweep of its armed forepaw.

P. Martin describes the life of the tamandua as follows: "With its prehensile tail, the tamandua tests out the firmness of every branch it walks on. In the thick foliage of the jungle tree tops it is safe from man and is only to be seen when it is breaking through the bark of a tree to reach a hive of wild bees, or a nest of termites. While thus engaged it is very easy to shoot down. This, however, does not mean that it can be collected immediately, for the hunter has to wait half a day before the dead animal loses its tail grip and falls to the ground. Several times we succeeded in catching a tamandua that could be reached from the ground. We caught it by the tail and carried it home in this way. We discovered that when it was frightened it stood erect with limbs extended and hissed like a goose — the only sound we ever heard it utter. When it was put on a branch which had been eaten by termites, the tamandua stuck its long tongue into the holes so that it came out on the other side."

Very little is known about the breeding habits of the tamandua.

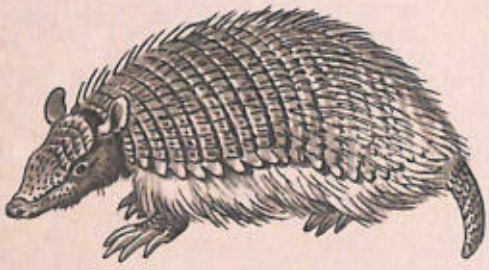
ARMADILLOS

Family DASYPODIDAE

As already mentioned, the name Edentata does not fit all the species in this order for the armadillos have more teeth than any other land mammal — from ninety six to one hundred and four. A characteristic commor to all the armadillos is their armour, which is formed of small bony discs with a horny covering. The bony plates are the ossified corium of the skin, while the horny surface is a modification of the skin's outer surface. The armour covers the head as well as the body and the eyes are protected by a special pouch. The body armour has several bands joined by a soft, pliable skin and these "joints" enable the armadillo to coil to some extent. One species can roll itself into a ball like a hedgehog. The bands and the shape of the individual plates are important in distinguishing one species from another. The armadillos have thick, strong claws, and the forefeet with their powerful claws are adapted for digging. They are all accomplished burrowers.

When digging, the armadillo uses not only its forefeet; it uses its snout as well, after the fashion of the wild boar. It digs tunnels up to 1½ yards deep and 5 yards long which lead to its underground lair. The animals come out to hunt only at night and dig into old tree stumps and

Giant Armadillo



Hairy Armadillo

Nine-banded Armadillo

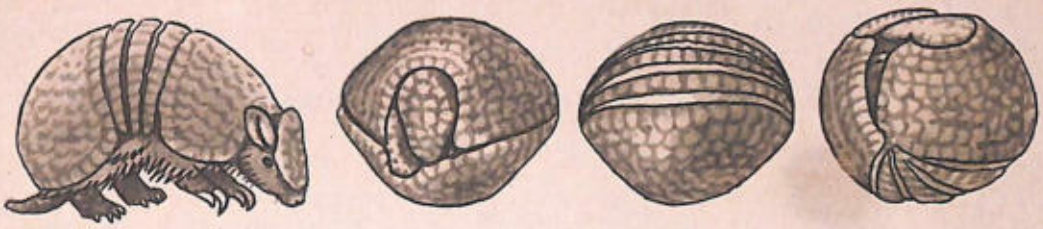
ant-hills with snout and forefeet. They feed mostly on insects, larvae and small vertebrates, but also take sweet fruits and other parts of plants.

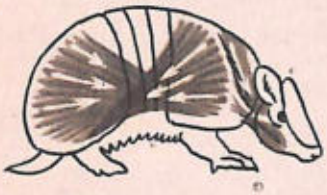
A prodigious exhibition of digging was given by a giant armadillo about one yard long. It had been placed in the lion's cage at a zoo because it had already bent the bars of another cage with its front feet and escaped. When it had to be photographed it was put down on hard asphalt, but before the cameras could be focused it had disappeared through the asphalt all but the tail.

The sexes meet only during the mating season. Outside it, the males and females live apart and only the female cares for the young. At birth, the armadillo's armour is soft, but after some weeks it begins to ossify and harden.

Most armadillos inhabit South America but some species are found in Central America and in the southern states of the United States. They are hunted everywhere. The local inhabitants consider their meat a delicacy and farmers persecute them because their burrowing damages the fields. Horsemen do not like them. Riders are often thrown when their horse breaks into an armadillo's tunnel and stumbles, sometimes breaking a leg. In spite of all this persecution, armadillos are still plentiful. They can smell an enemy a long way off and are well nigh impossible to reach once they have dug themselves in. Many hunters set traps for them at the tunnel entrances.

Only two species are really rare today — the Giant Armadillo, and the non-burrowing **Three-banded Armadillo,** which is the only species that can roll itself into a perfect ball like a hedgehog. This affords it excellent protection against beasts of prey but none at all against man.





Brazilian Three-banded Armadillo

The **Giant Armadillo** inhabits tropical South America and is the largest species. It is one yard long, excluding its tail, and weighs over 100 pounds. It is found mainly in Paraguay but is nowhere numerous. It is an expert burrower.

The **Hairy Armadillo** is the most numerous species. It is about 19 inches long and is the most accomplished burrower of all. The armour is only slightly curved and there are six to eight hinged bands. The hairy armadillo cannot coil itself into a ball. Its body is covered with fairly long sparse hair. This species is found on the pampas of Uruguay, the Argentine and Bolivia. It thrives and breeds in captivity

The **Nine-banded Armadillo** has markedly arched armour and nine hinged bands. It is about 16 inches long and has large donkey-like ears, and a tapering head. This species is found from the Argentine up to the Southern parts of North America and has been found at a height of over 9,000 feet above sea level.

ORDER: PHOLIDOTA

PANGOLINS

Family MANIDAE

This group of mammals was earlier classified with the Edentates. Now it is rightly placed in a separate order as scientific research has proved the earlier accepted relationship to be incorrect.

Pangolins are bizarre animals, the body being covered with horny scales so that it looks like a giant pine cone. These scales overlap and are similar to the scales of reptiles. Some species have bristly hairs growing under the scales. The scales cover almost the whole body surface as well as the long tail. The number is the same in each species.

Pangolins have a well developed anal gland with a foul smelling secretion which is expelled in self defence but also plays an important part in bringing the sexes together. The animals are guided chiefly by smell and the males probably find the females during the breeding season by means of the secretions of this gland. The mammary glands and teats of the pangolins are on the breast or in the axilla.

The pangolins dig up ant-hills with their powerful fore claws and catch the attacking ants, or termites, on their long sticky worm-like tongues. The tongue is contained in a special sheath which reaches down to the breast bone and the sticky saliva is secreted by a gland which extends down the throat as far as the front limbs.

The pangolin suffers hardly at all from the counter attack of ants. By closing its eyes and nostrils it bars these sensitive places against its attackers. Overlapping scales protect its upper parts. At intervals, the animal jumps into the air, spreads its limbs and comes down flat, thus crushing the ants biting at its abdomen.

The stomach of the pangolins is a perfect substitute for teeth, being lined with horny knobs which operate by muscular contraction to grind the ants and termites into pulp. In the pangolins we see how a similar environment can produce a similar adaptation of certain organs of the body. The stomachs of birds and ant-eaters are adapted in the same way.

In captivity, pangolins must be fed on the same mixture as the ant-eater, but they rarely thrive and usually die in a short time. Further study of the animals in the field will be necessary before they can be kept successfully in zoos.

Smell is the pangolin's best developed sense but its hearing is also good. The eyes are very small; even in the larger species they are barely the size of a pea. The eyelids are very thick as a protection against attacking ants.

Pangolins inhabit forests, or the trees and bushes of plains. They are nocturnal animals and sleep during the day rolled into a ball in a burrow or hollow tree. Some species are arboreal and have prehensile tails. On the ground, they move slowly with a rolling gait and sometimes a pangolin will walk on its hind legs using its muscled tail as a support.

Otherwise not much is known about the pangolin's life. For example, the period of gestation is not known. The young at birth is comparatively well developed. It is born with its eyes open and the female carries it for a long time, either on her back or at the

root of her strong tail. If a mother with young is attacked, she puts the young on her abdomen, coils into a ball and winds her tail round herself.

Like the Edentates, the pangolin has an unstable body temperature.

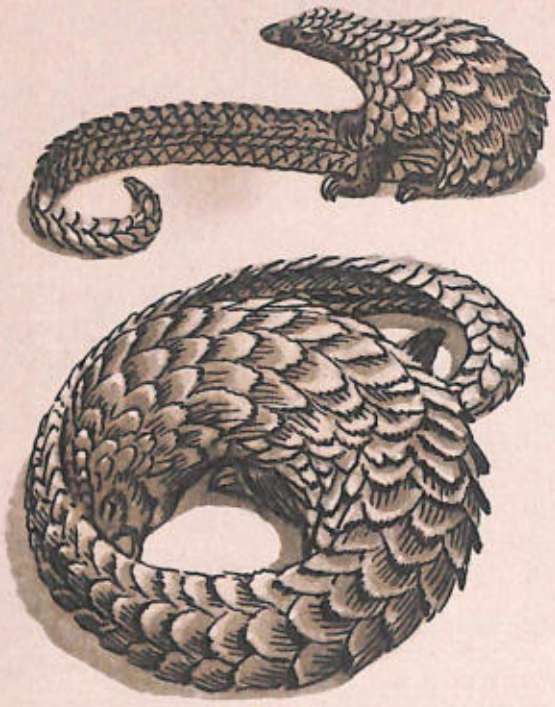
There are seven species of these strange animals in this group, some of them in Asia and some in Africa. The Asian pangolins have well developed ears, and there are hairs behind their scales, even in old mature specimens. The scales on the tail grow in regular rows.

Giant Pangolin

The **Chinese Pangolin** is the most numerous and is found in India and Ceylon. It has been described by Elliot as follows: "This species digs tunnels from two to four yards in length which lead into a kettle-shaped chamber about half a yard wide. In these lairs, the Chinese pangolins live in pairs and in March the female bears from one to two young. When the pangolin enters its lair it closes the entrance so perfectly that it is difficult to locate afterwards. A female which I kept in captivity, slept all day and was active only at night. She did not want to eat either termites or ants, although her droppings showed that she had eaten them before but she was always ready to drink, putting her long tongue in and out of the water so quickly that the water was foaming. When caught up, or otherwise disturbed, she chirped and spluttered."

African Pangolin

African Pangolins have no ears, the scales on their tails are irregularly arranged, and only the young have hairs behind the tail.



Long-tailed Pangolin

The **Small-scaled Tree Pangolin** is a representative of this group. Compared with the Asian pangolins, it is a slender animal with a prehensile tail which is longer than its body and naked at the tip. It is an excellent climber.

The **Long-tailed Pangolin** is found in West Africa. Its overall length is from 3 to 4 feet, about two-thirds of this being tail; in young animals, the tail is relatively longer than in adults.

The **Giant Pangolin** is the largest species of all, measuring 6 feet in length with a comparatively short tail. The giant pangolin may be no more than a geographical race of the cape pangolin.

The **Cape Pangolin** is called *abu-khirfa* by Kordofan hunters, which means "Father of the tree bark". It is found in Asia, West and South Africa.

ORDER: LAGOMORPHA

Hares and rabbits were at one time classified with rodents in a single order — the Rodentia. Modern zoologists, however, have separated them because it is now realised that their similarities are due to a similar way of life and not to any real relationship. As far back as the Tertiary Era, the species known to have existed differed from each other in the same way as the hares and rodents of to-day.

Lagomorph means "hare shaped" and it is this group to which hares, rabbits and pikas belong. Unlike the rodents, which have a single incisor on each side of the upper and lower jaws, the lagomorphs have two incisors on each side, the second and smaller being situated behind the front ones. These teeth are chisel-like and grow continually, being kept down by gnawing. There are no canine teeth. As in the rodents there is a long gap between the incisors and the cheek teeth. When chewing food, the lagomorphs move their lower jaw from left to right; that is, transversely.

All lagomorphs are herbivorous and most of them are social. Their distribution is now almost worldwide (some, like the rabbit, having been spread by man), and they occur in lowlands and on mountains, on grasslands and on the steppes. Their general way of life is similar to that of the rodents.

There are two families in this order, the pikas in one and the rabbits and hares in the other.

PIKAS
Family OCHOTONIDAE

Pikas are smaller than rabbits. They have short, rounded ears, no obvious tail, and their legs are all the same length. There are two species in North America and twelve in Asia. Their upper incisors are wide-set, double furrowed and deeply pointed.

The Asian species live at higher altitudes, on mountain plateaux. Their call is a high-pitched bleating sound which can be heard a long way off. From this they derive their name of "calling hares".

The **Steppes Pika** is about 6 inches long and is the only species whose range extends into Europe. Throughout the year it has a soft coat which is greyish-brown above and whitish below. In the Soviet Union it inhabits the Upper Volga, the Southern Urals and Northern Kazachstan; southwards its range extends to Northern Burma, Assam, Kashmir and China. It lives in valleys and sheltered places with abundant vegetation, but is also found high up in mountains.

Pikas dig tunnels about one yard long, ending in a larger chamber. Like rabbits, they live in colonies, so that a number of tunnels can usually be found in one place. The pikas do not hibernate. They remain active throughout the winter, although they may remain underground for long periods during the worst of the weather.

Steppes Pika

In the summer, they cut grass and spread it on the rocks to dry in the sun. Once it has been made into hay it is carried below ground and built into tiny haystacks to provide a winter food supply. For this reason, the pikas are often called "haystack builders". Apart from their haymaking activities, the pikas emerge mainly at dusk.

The **Alpine Pika** is bigger than the steppes pika, being from $6^3/_4$ inches to $9^3/_4$ inches in length. It inhabits the ridges of Altaj and Sajan, in the mountains behind the Bajkal Lake, and in Mongolia.

Bannikov, who made a detailed study of this species, found that it lives in fields surrounded by mountain steppe or tundra, and among the boulders of glacial moraines. In the Chu alps, it ranges from 5,000 up to nearly 6,000 feet, but in the Gobi altaj it has been found at 10,000 feet above sea level. Bannikov observed that the alpine pika digs its tunnels in rocky soil and among stones and hides its food stores under rocky ledges. According to Kolosov, this species stores mainly certain grasses and sedges, especially in the Chu alps. Soviet zoologists have identified fifty-nine different plants and grasses in the food stores of alpine pikas in Mongolia. These included seven different kinds of shrub and three kinds of semi-shrub. Bannikov has recorded. "At Ichebogdo, where I spent the night among a colony of alpine pikas, I saw the first animals above ground at 5.10 pm; the last one came out of the rocks at deep dusk at 10.20 pm. The pikas were active on and off throughout the day except about midday when their activity considerably lessened."

According to Kuznecov and Kolosov, the whole colony of pikas comes to life about nine o'clock in the evening.

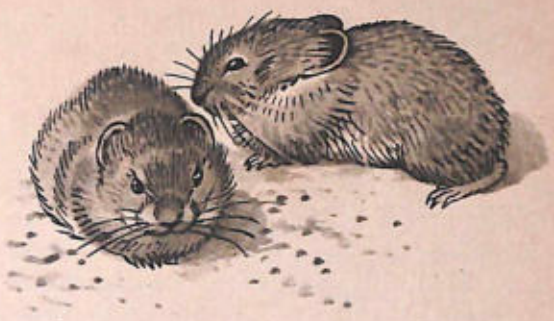
Research work carried out in the region of the eastern altaj has established that the alpine pika breeds twice a year. Breeding begins in the first half of May and the last litters of the year are born in August. Litter size is usually two or three young. It appears that the pikas do not live through a second winter. Not a single animal of two years old was caught during the entire research period.

The **Northern Pika** is distributed over most of Eastern Asia and ranges beyond the polar circle. It is closely related to the alpine pika but is smaller, measuring only $4\frac{1}{2}$ to $7^3/_4$ inches in length.

Hanzak had an opportunity to observe a northern pika in the Berlin zoological museum. It had been brought to Europe by Professor Zimmerman when he returned from North China. The pika was in a roomy cage which stood on a long table. The cage door was always left wide open so that the pika could come out and run about on the table whenever it wanted to. It did not behave in a wild manner and remained quiet, even when somebody approached its cage. But it left the cage only when there was absolute quiet in the room. Silent as a wraith, the little living ball of fur moved about the table, but at

the slightest rustle in the room, it fled back into its cage. Although this pika survived the long journey from China, it did not live long in captivity.

The **Rocky Mountain Pika** is the better known of the two North American species. It inhabits the northern regions of the Rocky Mountains and resembles the Asiatic pikas to which it is closely related. It is rarely seen in zoological gardens.



Rocky Mountain Pika

RABBITS AND HARES
Family LEPORIDAE

Hares and rabbits belong to this family. In general, hares have very long hind legs and ears that are longer than their heads. In rabbits, the hind legs are not so conspicuously long and the ears are shorter than the head. All the Leporidae are herbivorous.

The Leporidae are found in most parts of the world wherever there is a suitable environment. They did not exist in Australia, New Zealand or Madagascar but were introduced there by man in modern times.

There is an old hunting proverb which says that for each hare that goes out alone in the fields in spring, fifteen will return there in the autumn. This proverb is based on the fact that the Leporidae have several litters in the year and that the litters are sometimes large. It does not, however, take account of the fact that predation and other mortality factors tend to balance the birth rate so that violent population increases are usually temporary.

All the members of this family are good runners and some can attain a speed of up to 43 miles per hour. Speed is their main defence against their enemies. When moving slowly, they hop; they cannot walk. Only the fore paws can move individually; the hind legs always move together. Leporidae have five toes on their fore paws and four on their hind paws.

The **Brown Hare** inhabits all Western Europe, south to the Mediterranean and east to Western Asia, Asia Minor and Persia. It has been introduced to Australia, New Zealand, Scandinavia, Finland, Chile and North America. In 1964, Bobrinsky recorded that the brown hare had penetrated on a wide front between the Southern Urals and the Caspian Sea in the direction of the Irtysh river far to the east. Since then it has spread into East Africa. Its widening range appears to be influenced by the spread of agriculture.

Hares like plains and low rolling ground, and their density is highest on fertile lowlands near cultivation. They are often woodland, but never forest, animals. In areas of extensive forests they live on the tree fringe; in Great Britain, they

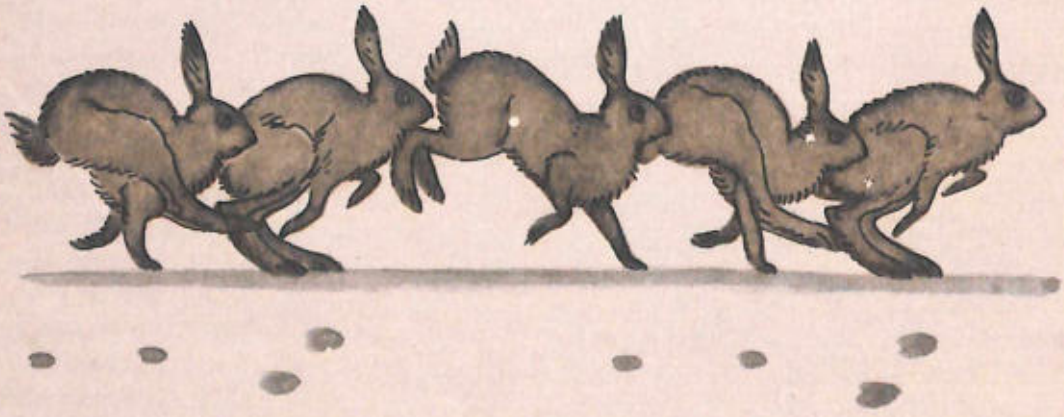
range up to 2,000 feet in some parts but usually to about 1,000 feet in Scotland — the level to which the mountain hare comes down. In Europe, it has been recorded at 3,000 feet and 3,600 feet. The density of hares falls as the contours rise towards hilly and mountainous country.

Populations fluctuate irregularly with no sign of a definite cycle between abundance and scarcity. Densities have been recorded as one hare to 10 acres for England, one to 2.5 acres for France and 1 to 1.25 acres in Czechoslovakia. But these densities vary greatly and there is no doubt at all that in peak years, English densities will equal the French.

A fully-grown hare measures 29½ to 31½ inches in length, including 3 to 4 inches of tail. These are Continental measurements: hares in Great Britain are generally smaller than this, averaging 26 inches in body length with a tail of 4 inches. The average weight of British hares is about 7 pounds 10 ounces (range 7 to 8½ pounds), which is near the Continental average. In Prague Museum, there is a specimen that weighed over 16 pounds.

The colour of the brown hare's coat varies little from season to season, but the fur is denser in winter. In Great Britain, the winter coat is denser than the summer one and greyer. There is, however, some regional variation. In the sandy areas along the Baltic sea coast, the hares are light beige in colour, whereas on peaty soil they are darker. From time to time, a black hare, or an albino, makes a rare appearance among its normally coloured rusty-brown fellows. The fur of the brown hare is not very valuable because it sheds readily and it is used mainly for making felt for hats. Unlike the rabbit, the hare has black tipped ears which are longer than the rabbit's. It also has black-tipped hairs on its back.

The brown hare is active at nightfall and dawn and probably throughout the night as well. It spends the day sleeping in its form. Woodland hares have regular pathways to their feeding grounds and these paths are often very distinct. They pass through tall herbage and under shrubs and are trodden down by constant use, all plants interfering with passage having been bitten off. When the paths reach the edge of a field they branch out



Action of a running hare, showing tracks in the snow

and gradually become lost in the open.

On her range the hare has several forms, all sited to give shelter and a view, and she will move from one to the other according to changes in wind and weather or disturbance. The hare hollows out her form by scraping or pressing with her body. It may be in a tussock or under a bush, near a clod in a field, on the edge of a wood, inside the wood, or in full view. The hare lies in her form with her legs folded under her and her ears laid along her back.

From her form, the hare can watch an approaching enemy and she will allow him to approach within a few yards before breaking away. This watchfulness has given rise to the legend that she sleeps with her eyes open and many people insist that they have observed this. In fact, the hare closes her eyes in sleep and is awake when they are open. This can easily be observed in captive animals. Like the adults, small leverets crouch in their form until the very last moment before breaking away.

When returning to her form, the hare takes certain precautions which are entirely instinctive. She breaks her trail by making great sideways leaps and she will make such leaps two or three times. One animal was observed making seven such leaps. Only when she has thus broken her line does the hare enter her form and lie down. Young hares behave in the same instinctive way and this behaviour can be deduced from the pattern of tracks in snow.

The main food of the hare is grass and other green stuffs, but it also takes agricultural crops and is fond of turnips. When the hare is eating a turnip it strips down the outer skin and then gnaws at the pulp. It will eat tubers and other

Brown Hare

fleshy roots but does not dig for them. It has been recorded eating fungi and Gewdorf records vole as an item. Captive hares will certainly take flesh food at times. In autumn and winter, the hare can do a lot of damage by barking trees and it will browse extensively on bushes. Where bushes and herbs are available in quantity, the hare tends to eat them and leave forest seedlings alone. Hares are said never to drink and it is true that the water content in their food is usually sufficient. In addition, the herbage is usually wet when the hares feed. Nevertheless, wild hares have been seen to drink and tame hares readily do so.

Because of her speed, the hare can outrun most of her enemies, although she is hard-pressed when coursed by a greyhound. She runs best uphill and will not run downhill if she can avoid doing so because her hind legs are then a handicap and at high speed she is liable to turn somersaults. When her pursuer presses too close upon her she will try to gain ground by sudden twists and changes of direction. She will leap over high obstacles, swim, or run where her scent will be hidden.

Speed, endurance, cunning and breaking of her trail are her only defences against ground predators. She has no defensive weapons against birds of prey like goshawks and eagle owls, which attack her from above. She is absolutely defenceless and if there is no cover in which she can immediately take refuge she is lost. When caught by a wild carnivore or a dog she screams like a child and her cries can be heard a long way off. Her cries frequently attract other beasts of prey and some European hunters imitate her scream, using mechanical means or by pressing their palms against their lips, to attract foxes within shooting distances. Nowadays, many hares are killed on the road by motor cars.

The hare swims well when she has to but she will also do so for no apparent reason. Hares have been observed swimming across rivers, including the Rhine at a point where it was 500 yards wide. Those living in swampy areas, or near the coast, enter water readily and are accomplished swimmers. During floods, the hare will seek higher ground or temporary islets, or cling to rocks or even climb into low branches.

In winter, the hare will scrape through the snow to reach grass or winter cereals. During prolonged snow, she will eat bark. At such times, a hare may be snowed up in her form, or lie up in a snow drift, or under a bank with an air hole opening to the outside world. Some individuals will occupy such "snow-forms" for days on end. At times, chiefly in the morning, the vapour of the animal's breath can be seen escaping from the entrance.

The sexes cannot be distinguished in the field, although hunters often maintain that they can do so. In fact, sex can only be determined by examination of the sexual organs, which means having the animal in the hand.

Hares, traditionally, go mad in March, thus heralding the onset of the main breeding season, the peak of which is reached in the period from March to July. But the breeding season extends to September and leverets are born in all months from February to October and even later. About half the females are pregnant in the first three months of the year and the whole population from May to July according to Kolosov. Between September and December about 15 per cent of the hares are pregnant. However, many of the young hares conceived are never born. They die in the womb and are reabsorbed by the mother's tissues. Such intra-uterine losses are higher in the autumn.

During their mating assemblies (the March assemblies have been most observed, hence the mad March Hare), the jack hares threaten each other and fight for females, sitting up on their hind legs and boxing with their fore paws. Sometimes the fur flies. A jack will follow a jill hare up and down hedgerows and across fields until she is ready to breed. After that she goes her own way and her leverets never know their father. Chases go on all through the season but not much is seen of them by the casual observer once the ground cover grows up.

The first litters of leverets usually appear in February, but sometimes in January, even when the ground is covered with snow. The young are born fully furred with their eyes open. They are born usually in a sheltered spot under a bush or hedge or in thick ground cover. They are able to run about from the beginning and very soon each seeks out a form of its own. The doe hare visits them to suckle them. Otherwise, she pays

little attention to them. However, if they are threatened, for example by a crow or a bird of prey, she will defend them with great courage. She will even attack a stoat. Hares have been regularly observed driving off sheep and cattle from their young.

The leverets grow quickly and they are independent at one month old. At the age of one week, they begin to nibble grass and other plants. The doe hare breeds three or four times a year, although she may not produce three or four litters. Litter size varies from one to four.

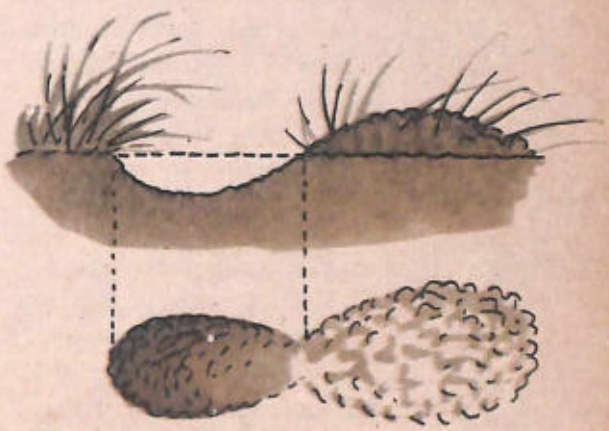
It is known that the female can become pregnant while pregnant. This phenomenon is called superfetation, but it is not known in what circumstances superfetation occurs or if it is of general occurrence.

Of great importance in the life of the brown hare are its odoriferous skin glands. These are two glands in the skin fold inside the mouth on the inner side of the cheek. When cleaning herself with her fore paws the hare presses out a secretion which clings to them. In the further process of cleaning, this scent is then transferred to the rest of her body. The scent is rubbed off by the hare when she is moving about her territory and is a form of advertisement to the opposite sex. In addition to these skin glands there is another on the snout and a pair on either side of the anus. These glands have special secretions by means of which the hare marks its territory and advertises possible meeting places to members of the opposite sex.

The **Blue Hare** ranges over Northern Europe and Asia. In Europe it is found in the whole of Scandinavia, in the Alps, in Northern Poland, and southwards to a line connecting Kiev and Voronesh. In some parts of its range, the territory of the brown hare overlaps with this species. Sixteen sub-species of the blue hare have been described. Of these, the most interesting are those that have been isolated for a long time in the British Isles and in the mountains of Central Europe. The three races are as follows:

1. the Scottish Mountain Hare, found in the mountains of Scotland;
2. the Irish Hare, which is found in Ireland and
3. the Varying Hare, which inhabits almost the whole region of the Alps at about the same altitude as the marmot and the Alpine ibex — that is above 4,000 feet.

In the glacial period, the blue hare was spread over most of ice-free Europe. This has been established by the finding of numerous skeletons, mostly excavated from caves. As the climate grew warmer and the glaciers retreated slowly northwards, the blue hares moved with the frontier. Some, however, moved into the high mountains of Europe and there, in higher and colder altitudes, they still live as reminders of the fauna of the glacier epoch. Isolated from their original habitat, and exposed to the influence of a different



Section of "form" of Brown Hare

Speed, endurance, cunning and breaking of her trail are her only defences against ground predators. She has no defensive weapons against birds of prey like goshawks and eagle owls, which attack her from above. She is absolutely defenceless and if there is no cover in which she can immediately take refuge she is lost. When caught by a wild carnivore or a dog she screams like a child and her cries can be heard a long way off. Her cries frequently attract other beasts of prey and some European hunters imitate her scream, using mechanical means or by pressing their palms against their lips, to attract foxes within shooting distances. Nowadays, many hares are killed on the road by motor cars.

The hare swims well when she has to but she will also do so for no apparent reason. Hares have been observed swimming across rivers, including the Rhine at a point where it was 500 yards wide. Those living in swampy areas, or near the coast, enter water readily and are accomplished swimmers. During floods, the hare will seek higher ground or temporary islets, or cling to rocks or even climb into low branches.

In winter, the hare will scrape through the snow to reach grass or winter cereals. During prolonged snow, she will eat bark. At such times, a hare may be snowed up in her form, or lie up in a snow drift, or under a bank with an air hole opening to the outside world. Some individuals will occupy such "snow-forms" for days on end. At times, chiefly in the morning, the vapour of the animal's breath can be seen escaping from the entrance.

The sexes cannot be distinguished in the field, although hunters often maintain that they can do so. In fact, sex can only be determined by examination of the sexual organs, which means having the animal in the hand.

Hares, traditionally, go mad in March, thus heralding the onset of the main breeding season, the peak of which is reached in the period from March to July. But the breeding season extends to September and leverets are born in all months from February to October and even later. About half the females are pregnant in the first three months of the year and the whole population from May to July according to Kolosov. Between September and December about 15 per cent of the hares are pregnant. However, many of the young hares conceived are never born. They die in the womb and are reabsorbed by the mother's tissues. Such intra-uterine losses are higher in the autumn.

During their mating assemblies (the March assemblies have been most observed, hence the mad March Hare), the jack hares threaten each other and fight for females, sitting up on their hind legs and boxing with their fore paws. Sometimes the fur flies. A jack will follow a jill hare up and down hedgerows and across fields until she is ready to breed. After that she goes her own way and her leverets never know their father. Chases go on all through the season but not much is seen of them by the casual observer once the ground cover grows up.

The first litters of leverets usually appear in February, but sometimes in January, even when the ground is covered with snow. The young are born fully furred with their eyes open. They are born usually in a sheltered spot under a bush or hedge or in thick ground cover. They are able to run about from the beginning and very soon each seeks out a form of its own. The doe hare visits them to suckle them. Otherwise, she pays

little attention to them. However, if they are threatened, for example by a crow or a bird of prey, she will defend them with great courage. She will even attack a stoat. Hares have been regularly observed driving off sheep and cattle from their young.

The leverets grow quickly and they are independent at one month old. At the age of one week, they begin to nibble grass and other plants. The doe hare breeds three or four times a year, although she may not produce three or four litters. Litter size varies from one to four.

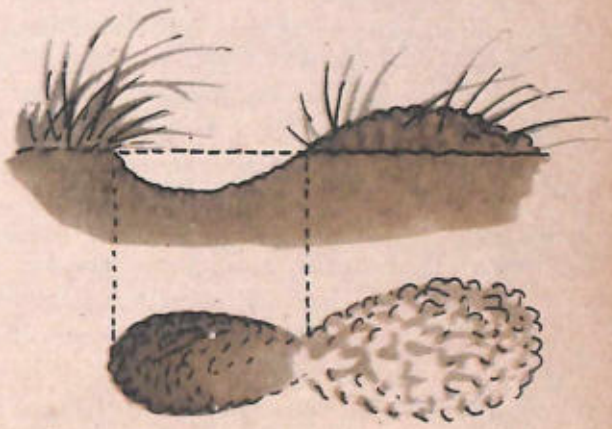
It is known that the female can become pregnant while pregnant. This phenomenon is called superfetation, but it is not known in what circumstances superfetation occurs or if it is of general occurrence.

Of great importance in the life of the brown hare are its odoriferous skin glands. These are two glands in the skin fold inside the mouth on the inner side of the cheek. When cleaning herself with her fore paws the hare presses out a secretion which clings to them. In the further process of cleaning, this scent is then transferred to the rest of her body. The scent is rubbed off by the hare when she is moving about her territory and is a form of advertisement to the opposite sex. In addition to these skin glands there is another on the snout and a pair on either side of the anus. These glands have special secretions by means of which the hare marks its territory and advertises possible meeting places to members of the opposite sex.

The **Blue Hare** ranges over Northern Europe and Asia. In Europe it is found in the whole of Scandinavia, in the Alps, in Northern Poland, and southwards to a line connecting Kiev and Voronesh. In some parts of its range, the territory of the brown hare overlaps with this species. Sixteen sub-species of the blue hare have been described. Of these, the most interesting are those that have been isolated for a long time in the British Isles and in the mountains of Central Europe. The three races are as follows:

1. the Scottish Mountain Hare, found in the mountains of Scotland;
2. the Irish Hare, which is found in Ireland and
3. the Varying Hare, which inhabits almost the whole region of the Alps at about the same altitude as the marmot and the Alpine ibex — that is above 4,000 feet.

In the glacial period, the blue hare was spread over most of ice-free Europe. This has been established by the finding of numerous skeletons, mostly excavated from caves. As the climate grew warmer and the glaciers retreated slowly northwards, the blue hares moved with the frontier. Some, however, moved into the high mountains of Europe and there, in higher and colder altitudes, they still live as reminders of the fauna of the glacier epoch. Isolated from their original habitat, and exposed to the influence of a different



Section of "form" of Brown Hare

environment, they have developed their own characteristics and are now a separate race.

The summer coat of the blue hare is rusty-brown but this becomes white in winter and only the tips of the ears remain black. The hind legs are covered with thick hair. Whereas the top side of the tail of the brown hare is black or blackish brown, the upper surface of the blue hare's tail is greyish in summer and white in winter. The blue hare's ears are shorter than the brown hare's. On average it is much lighter in weight than the brown hare but weight varies considerably over its range.

The blue hare changes colour twice in the year but there are actually three moults, white to brown in spring, brown to brown in autumn, and brown to white in winter. It is often said in books on natural history that this hare's change to white in winter is an example of protective coloration, and it has to be admitted that the white fur matches the snow, thus concealing the hare from the view of its enemies — the arctic fox, the owl, the eagle and other birds of prey. This can be compared to the donning of white capes by soldiers when they are fighting against a snowy landscape. Nevertheless, the white winter coat of the blue hare is not always an advantage. During a sudden thaw it becomes very conspicuous against the dark background and, in fact, the hares will seek out ground clear of snow, if there is any, when feeding.

Unlike the brown hare, the blue frequently goes to ground, and spends much time in shallow burrows or under peat overhangs. In such places she gives birth to her families, which number two or three in a season, with from five to eight young in a litter. Like young brown hares, they are born furred and with their eyes open and are able to run about soon after birth. The number of blue hares fluctuates considerably over the years. In one season an area may be swarming with them, while in the next it appears that all the animals on the range have died out. These fluctuations, however, are in no way regular, and increases or declines do not occur simultaneously throughout the animal's range. Statistics based on trapping returns show that, in the U.S.S.R., years of high density occur at intervals of from eight to twelve years in the Siberian forest steppes, while in the forest regions of European Russia they occur at intervals of four to nine years. Although many authors have published their views on this matter in the scientific literature, we still know as little about the causes of these fluctuations in hares as we do about field mice. One thing, however, has become clear and that is that years of high hare density are years of high density among their predators. So the fluctuations of hares and predators would appear to be related. Among the blue hare's enemies are the snowy owl, the arctic fox, the red fox, the wolf and the kite.

The blue hare is well adapted for its rigorous life. Its thick winter fur protects it from the cold and its great hairy feet act like snowshoes, so that it can skim over the snow drifts without sinking and is thus able to escape from danger. During icy winds, or prolonged blizzards, it simply snuggles down in a crevice under a rock and lets the snow drift over it. Under the snow it is comfortably warm, and able to breathe through a surface hole which is kept open by its own warm breath. It is said to be able to find food under the snow by means of scraping. In the open areas of Central Asia, the blue hare shel-

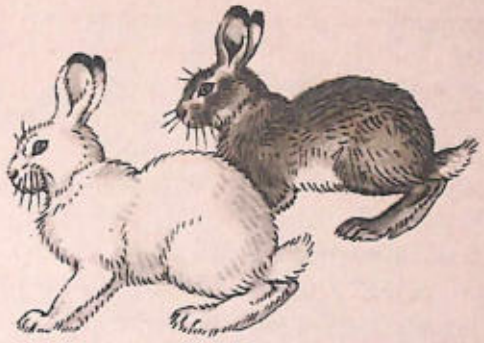
ters from its enemies or inclement weather by digging shallow burrows in the snow or by hiding in the burrows of marmots.

The **Alpine Varying Hare** is smaller than the typical race. Its hair is thinner and its head and ears shorter. In summer, the coat is greyish-brown and in winter white. In its winter coat it retains its black ear tips. "In summer," says Baumann, "the alpine hare lives in rocky and unforested areas up to the snow line. Its burrow, in which it spends the day, is often situated near snow, among rocks, under roots or clumps of rhododendrons. In winter it moves down towards the upper border of the forests. During heavy blizzards, it allows itself to be completely snowed in. The species does not seem to be bound to a territory like the brown hare."

It is interesting to note that in lower altitudes, the blue hare will occupy the same ground as the brown, and in the high mountains of Slovakia it is the brown hare that lives at high altitudes. Because of this it was for long believed that the blue hare lived in the Tatra mountains of Czechoslovakia. In fact, it has never been recorded in the Czechoslovakian mountains, and old records relating to its occurence in the Tatras have not been substantiated.

The **Scottish Mountain Hare** is found on most Scottish mountains above 1,000 feet and lives high until it is driven down by blizzards or deep snow. In Scotland its main enemies are the mountain fox, the wild cat and the golden eagle.

The Scottish mountain hare is the only British mammal, apart from the stoat, that changes to white in winter. Its summer coat is dusky, or deep brown, or



Blue Hare

grizzled, with a bluish tinge. The ear tips are black, the tail is white. The complete winter coat is white except for the black ear tips and a few black hairs on the back. In Britain, there is, quite frequently, only a partial change of coat so that the animals remain patchy.

The blue hare of the Scottish mountains measures up to two feet long, including the tail which may be up to three inches long. Weight ranges from 5 to 7 pounds, females being a little heavier than males.

As in the brown hare, the peak of the breeding season is in March, but gatherings are sometimes to be seen in February when the hills are white with snow. The decline of the breeding season is in July and the last leverets are born in August. Litters in June are usually the biggest. On mountain and moorland, the typical food of the Scottish hare is heather throughout the year. But it also eats cotton grass, especially in the spring, and sedges and other grasses in the summer. During very severe winters, the mountain hare will eat lichens and even the cones of the Scots pine. At times they eat rushes and whin. On grassy hillsides they replace their heather diet with grass, sedges and flowering plants.

In Scotland, shepherds wage war on the

Polar Hare

mountain hare, mainly because it is a competitor with the sheep for grass and heather. Early in the year, hare drives are held when the animals are driven to waiting guns on moor and mountain side. Such big drives used to be common. Although large numbers of mountain hares are shot each season they have never really been considered sporting animals. Apart from man, hill sheepdogs kill a number of leverets and sometimes adult hares. Other predators are golden eagles, foxes, wild cats, stoats and buzzards.

The mountain hares move up and down through the contours of their range according to changes in weather, and will move from one form to another to escape winds and storms. Prolonged blizzards will drive them from the high ground and if the snow lies they will remain on low ground for lengthy spells, moving up again as soon as conditions are suitable. But such movements are not always predictable.

Although mountain hares can be seen on foot by day and feeding by day, they are mainly crepuscular and nocturnal, feeding between dusk and daylight throughout the year. When the snow is lying the hares will feed on and off at all hours of the day and reingestion takes place then as in the brown hare.

The mountain hare is not as fleet as the brown, nor has it the brown hare's stamina. It also appears to lack the courage of the brown hare and cannot stand a hard run. A fast hill collie can run one down in the open.

Tolai Hare

In the extreme north of America there is a relative of the blue hare — the **Polar, or Arctic Hare.** Unlike the blue hare, this species is white all the year round except for its ear tips which are always black. The summer coat is not so strikingly white; it is rather greyish or frosted. The polar hare is highly suited to the cold climate in which it lives and could not exist anywhere else. It does not mind snow, frost, or blizzards. On the contrary, a mild winter, such as occurred in the years 1938 and 1939, affects it adversely and polar hares became almost extinct over wide areas in those years, although there had been great numbers of them on the ground before 1938.

Krumbiegel says: "Every day the polar hare sets out on its regular ramblings. It sleeps on floating ice, where it is safe from

foxes. During the day it stays on firm ground away from the coast. However, when the floes leave, it becomes a regular inhabitant of dry land."

Polar hares prefer to hide in drift ice on the shore.

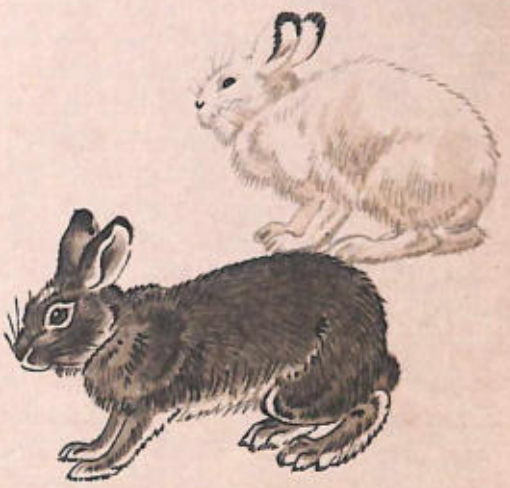
The **Cape Hare,** which does not weigh more than 7½ pounds, has black ear tips but the black is not always clearly defined. It is found over almost the whole of Africa, a large part of Asia, and the Iberian peninsula. It is now thought that the **Tolai Hare,** formerly considered a separate species is no more than a race of the Cape Hare.

The **Prairie Hare** is found in the mountains of Eastern Canada. It is about two feet long. It inhabits open regions. In forest areas lives the **American Varying Hare,** or **Snowshoe Hare,** which is often referred to as the **Snowshoe rabbit.**

The summer coat of the **Irish Hare** is much redder than that of the Scottish mountain hare and the Irish sub-species seldom makes the change to white. Some animals in fact show no signs of white at all. Irish hares tend to be bigger and heavier than the Scottish race.

The **European Rabbit** was originally confined to the Mediterranean area but is now found in many parts of the world, including Australia and New Zealand, where it has become a major pest. It found its own way into some parts of Europe and was introduced into others by man. The Normans brought it to England where it was at first confined in warrens, but it soon began to spread and was deliberately introduced into other parts of the country. It reached the Scottish Highlands in the

Prairie Hare



Snowshoe Hare

nineteenth century. Rabbits from Britain have been introduced into Australia, New Zealand and the United States of America.

Rabbits are smaller than hares, being about 16 inches in length and averaging 3¼ pounds in weight. The head, ears and hind legs are all relatively shorter than in the hare and the ear tips are not black. The general colour is grey or greyish-yellow, the underside of the short tail being white. The forelegs are muscular and well adapted for burrowing. The formation of the skull and certain

differences in the skeleton distinguish the rabbit from the hare.

Apart from being a burrower, which the brown hare is not, the rabbit is also highly gregarious, although some individuals appear to live in isolation, while others living in forest or among rocks lie above ground.

The biggest rabbit warrens are found in sandy, dry soil, which affords easy digging and such warrens are often extensive, undermining large areas. In each sector a hierarchal system prevails with a master buck dominating. The female rabbits, known as does, often make their breeding nest inside the main warren, digging a short burrow off the main tunnel for this purpose. The nest is made of withered grass, or bracken, mixed with wool from the doe rabbit's body. Other rabbits excavate their nesting burrow away from the warren. The rabbit scrapes with its fore paws and uses its hind feet to throw the earth behind it.

The doe's nesting burrow is known as a "stop". It is never very deep, usually little more than the length of a man's arm, and it is easily overlooked because the doe seals the entrance after visiting her young. She stops it up with soil which she pads firmly into place with her paws.

The doe visits her nursery to suckle her young several times between dusk and dawn. With much coming and going she disturbs the soil in the nest so that the earth at the entrance of the burrow becomes mixed with wool, thus betraying it to the observant eye. Sometimes the doe rabbit will spend most of the night lying up with her kits and very often she does not leave them until several hours after sunrise. Unlike young hares, young rabbits are blind and naked at birth. They open their eyes after ten days. The young are suckled for about three weeks and are self-supporting at the age of one month.

While they are in the nest the young rabbits may fall prey to foxes, badgers, stoats, weasels, hedgehogs, or even brown rats. Fox and badger will eat the young on the spot or carry away and hide what they cannot eat. The fox digs into the nest from the entrance; the badger often does so from a spot immediately overhead. A hedgehog may lie up in the nest after eating some of the young, or make repeated visits until all have been eaten. Stoat and weasel will kill them, then eat or drag them away for future use.

During the week after weaning, the young rabbits play about at the entrance to their nesting burrow, which sometimes becomes the nucleus of a new colony. If not, the young animals join the main warren.

It has long been known that the wild rabbit is a prolific breeder, but there are certain natural checks on this fecundity. Many litters are lost in the mother's womb, being reabsorbed into her tissues. Such losses are highest where rabbits are numerous on the ground and lowest where the population is low. Intra-uterine losses are therefore a built-in check on the rate of reproduction. Under favourable conditions, the doe rabbit will become pregnant from three to five times in the season, but it does not follow that she will produce five litters. Litter size varies from four to eight, and exceptional families of twelve young have been recorded. Pregnancy lasts from thirty to thirty-seven days.

Rabbits feed mainly in the evening and on and off during the night until sunrise, but they will often be seen grazing by day, or sitting near their burrows. They

eat a great variety of herbage and can do much damage to agricultural crops such as cereals, roots and grass. They also damage young trees. An adult rabbit will eat one pound or more of fresh green food every day. Because they are selective grazers rabbits can affect the natural vegetation of an area, and they can cause soil erosion by constantly feeding close to their burrows. Before the arrival of the diseases known as myxomatosis, they did incalculable harm to agriculture and are now officially classified as pest animals in Great Britain.

When myxomatosis first attacked rabbits it killed off about 98 per cent of their number. In areas which the disease could not reach by natural means, it was introduced by human agency; thus almost every island colony became affected. Small colonies living in remote mountain areas escaped, just like the rabbits on the uninhabited island of Noss in the Shetland group. Nowadays there is clear evidence that the disease is killing fewer rabbits and in many areas populations are building up again.

Adult rabbits are preyed upon by foxes, wild cats, eagles, wolves and other large carnivores. Before myxomatosis, the stoat preyed largely upon rabbits and was often killed in traps set for its prey. Weasels are

European Rabbit

able to kill very small rabbits, especially about the age of one month. Owls often attack young ones too. Man destroys the rabbit by shooting, snaring, trapping, ferreting and gassing.

Like the hare, the rabbit practises refection; that is to say, the contents of the bowel are reswallowed and passed through the body a second time. In this way, rabbits extract every atom of nourishment from their food.

The domestic rabbit, which man now breeds in many varieties, can interbreed with the wild type and escaped animals do so. This often accounts for the local appearance of pied rabbits, although pure white and black specimens occur naturally in wild populations. Some species of domestic rabbit are bred to provide meat, others to provide fur. Before myxomatosis the fur of rabbits was in great demand for making felt hats.

ORDER: RODENTIA

The teeth of rodents closely resemble those of the hares and rabbits, but there is only a single pair of incisors in the upper jaw. The name of this order is self-explanatory; it is applied to gnawing animals. The animals in this order have highly specialised teeth, and the skull of any rodent can be identified at first glance by their arrangement and type. Indeed the skull of a rodent can be mistaken for that of no other mammal.

The incisors of the rodents are curved and their front edges are as sharp as chisels. These chisel edges enable rodents to gnaw wood, seeds and other extremely hard substances such as the shells of nuts. How is it that rodents' incisors are so sharp? The answer is that they are not covered with enamel on all sides but only on the front. The back surface of the incisors consists of much softer dentine. During gnawing, this soft dentine wears down much more quickly than the enamel-covered front edge and this gives rise to the constantly sharp cutting edge. The enamel varies in colour from yellow to orange or reddish in different species. The different colouring of the teeth in different species may be important as a threat display to enemies.

The teeth of rodents, even small ones such as hamsters and dormice, are effective weapons — a fact that can be confirmed by anyone whose finger has been bitten through.

There is a further peculiarity about the teeth of rodents; they keep on growing. Their roots are deeply socketed in the jaws, as anyone can see by extracting a tooth from the lower jaw. In older skulls this is easily done.

As the teeth grow constantly, they have to be kept worn down, and this is achieved by gnawing. However, in squirrels and other rodents (as well as in hares and rabbits), we sometimes find imperfectly situated incisors, whose cutting edges are not placed directly opposite each other. As a result of this, the necessary grinding does not take place, and the teeth grow longer and longer until they curve right out of the mouth and even over the lips, like tusks. When this happens the animal starves to death because it can no longer eat.

Rodents have no canines, so that there is a wide gap between the incisors and the molars, called the diastema.

The grinding surface of the molars is not the same in all rodents. It may be flat or ridged or have protuberances. During the act of chewing, the molars of the lower jaw move backwards and not laterally as in other mammals.

Being herbivores, rodents have the typical long intestines which are five to fifteen times their body length. The appendix is also well developed. Some rodents also eat animal food. The body structure of the order varies widely, being adapted to the different ways of life of different species.

Rodents virtually occupy the world and are found wherever there is vegetation: they inhabit the tropics and the polar circles. They are found in lowlands, in forests, on high mountains and on steppes. They are found on the ground, under the ground, in rocks, in water and in trees — highly adaptable and apparently indestructible.

Most of them are very small animals, the largest being the capybara, which weighs up to 110 pounds. There are other large species, but the majority are mouse-size or only

a little bigger. Nevertheless, they are one of the most important orders in the animal kingdom, numerous in species and numerous in individuals. Over 1700 species have been described, and it is reckoned that two-fifths of the mammal species of the world are rodents. Many of them have followed man and colonised the world with him, helped by his activities and living at his expense. Their fecundity is proverbial and there seems to be no end to them. Despite constant predation by a large number of enemies, their numbers remain high. Yet, despite population explosions as in voles, spectacular increases are only temporary, due in some cases to built-in controls.

From time immemorial, rodents have been a major pest to man, sometimes threatening his harvests, his orchards, his forests and his grasslands. On the island of North Rona, the people died of starvation when rats, coming ashore from a wrecked ship, ate their entire food supply.

While attempting to control rodents, man has also been busy killing off their natural enemies, thus disturbing nature's equilibrium without solving any of his problems, and often indeed, making them worse. This happens because he acts before he fully understands what he is doing. One of his greatest mistakes, and one he still makes, is the routine killing of predators like stoats, weasels and owls, which are natural enemies of small rodents. Nowadays, he spends many millions of pounds on rodent-control and suffers damage to an extent that cannot be measured in terms of money.

But not all rodents are harmful to man's interests. From some he derives considerable benefit, chiefly in the way of meat and furs; others are a pest only some of the time.

SQUIRRELS
Family SCIURIDAE

To this family belong several groups of rodents which differ considerably from one another in general appearance — squirrels, susliks, ground squirrels, marmots and flying squirrels. On the other hand, they have many and more fundamental things in common, which make them members of the same family.

Sciuridae are animals of medium size. In the upper jaw, they have five molars on each side and in the lower jaw four on each side. The tail varies in length from species to species but is covered with hair in all of them. They are all land species, living in trees or on the ground but never in the water.

The **Red Squirrel** is perhaps the best known animal of this family and probably the one most easily recognised by most people. It is an attractive creature and a skilful climber, with a long bushy tail and tufted ears, and is a great favourite in public parks where it soon becomes tame and accepts titbits from people.

The red squirrel is found in the forests of Europe and Asia, from the northern tree limit to the Mediterranean and from Ireland to Japan, but is absent from Syria, Persia, Asia Minor and the Caucasus. It is found all over Britain except the Isle of Man. In the Channel Islands it occurs only on Jersey. In the late eighteenth and early nineteenth centuries it became almost extinct in Scotland, perhaps entirely

so, but was later reintroduced and is again a common forest animal especially in the great coniferous forests planted by the Forestry Commission.

Most red squirrels are reddish in colour but this varies considerably in certain parts of its range. There is a dark phase, varying from brown to black, which is found in many parts of Europe but whether black, brown, russet or bleached, all red squirrels have pure white under-fur. In Europe, both colour phases are often found on the same ground and this variation can be seen even in young from the same litter. The tendency, however, is for the red-coloured squirrels to inhabit lowland areas, while the dark variety predominates in mountain areas. In the high Tatras of Czechoslovakia there is a unique type which is almost black with a brick-red line of demarcation between the black upper and the white under-fur. This squirrel is therefore a tricolour. In Great Britain, the red squirrel's summer coat is chestnut-coloured, with grey on the crown. The winter fur is thick and long and brownish-grey on the upper parts; the tail is bushy and dark brown and the animal has prominent ear tufts. By spring, the colour has bleached and the squirrel is pale until it moults into its summer coat. The tail fur and ear tufts are changed only once a year. Any dark squirrels seen in Britain are the offspring of animals introduced from Scandinavia.

Eastern races of the red squirrel are greyer than those of the West and in Eastern Asia become almost pure grey with white bellies. In Russia, zoologists recognise red-tailed and brown-tailed varieties. There, the winter coat of the squirrels is very thick and of great value to the fur processing industry. According to the Soviet zoologist, Ognyev: "the value of the furs processed annually amounts on the average to 30 per cent of the total annual value of our fur trade."

The red squirrel measures from 15 to 16½ inches in length of which 6½ to 7½ inches is tail. Adults weigh up to 15½ ounces. The sexes look alike.

Red squirrels are forest animals and favour mainly dark coniferous forest. In many parts of Britain, they will be found in mixed woodlands and in hedgerow and roadside trees, where they live successfully, and in Europe there is dispersal into such areas after the breeding season. Nevertheless, the red squirrel is predominantly an inhabitant of mature coniferous forest.

They take a wide variety of foods, including some animal food. They eat buds, tender shoots, acorns, beech mast, the seeds of sycamore, pine, spruce and fir, the bark of young trees, wild fruits and fungi. In a garden, or orchard, they will eat plums, cherries, pears and strawberries. They are fond of Spanish chestnuts. They have been recorded eating many flowers and tubers. Animal food includes small birds and their eggs and young. Continental writers say that in the autumn squirrels consume chiefly fruits and seeds, changing in the spring to the buds and the bark of trees. They are also very fond of mushrooms and sometimes carry them into the tree tops where they either eat them, or store them for subsequent use by sticking them on twigs.

The cones of spruce and fir are, however, a main food, and it has been said that cones are to red squirrels what bread is to man. In years of abundant cone harvest the squirrel will live almost entirely on their seeds. When stripping a cone the squirrel squats down with it held between its forepaws and nibbles away the scales to reach the seeds. The scales drop to the

ground like snowflakes, and sometimes a few seeds fall as well, which take root under favourable conditions. The ground beneath a feeding tree soon becomes littered with the cores of cones and these are an indication of the presence of squirrels.

The squirrel is equally dexterous in dealing with hazel-nuts. Holding a nut in its hands the squirrel turns it round and round, cutting out a hole with its lower incisors, after which it cracks the nut open. Red squirrels are so fond of hazel-nuts that they will move in autumn to areas where they are plentiful. Siberian squirrels often undertake long excursions in search of such food. These excursions sometimes become almost a migration and, during such movements, squirrels have been seen swimming across rivers. The red squirrel is, nevertheless, a forest animal, rarely seen far from trees, and it dislikes crossing wide areas of open ground to get from one wood to another.

In broad-leaved forests, that is to say, forests of deciduous trees, the squirrels do not cause much damage. In coniferous woodland, however, they can do serious damage by eating the leading shoots and stripping the bark of trees. Early in the twentieth century, when red squirrels were numerous in Scotland, they destroyed 100,000 trees in one year in one forest. The trees most commonly attacked in Britain are Scots pine, larch and spruce.

The nest of the squirrel is called a drey and is a solid construction of twigs, grass and leaves, lined inside with moss, bark and grass. It is usually built in a fork against the main stem of the tree, twenty feet or more above the ground, and is bigger than a football. It has no obvious entry, or exit, so that the squirrel has to force an entry at each visit. European zoologists, studying Continental red squirrels, have noted an entrance at the bottom of the nest, and sometimes one near the tree trunk which they call the flight exit. This arrangement has so far not been noted in the nests of British red squirrels. Tufts of grass, twigs, etc., can often be seen in trees wedged in the branches. These are usually started but unfinished nests.

Continental squirrels will use nest boxes to live in, but the British race appears reluctant to do so.

Red squirrels breed from spring until the autumn and have one to three litters a year, numbering three to seven young, which are naked and blind at birth. The gestation period is six to seven weeks and the young squirrels open their eyes at the age of one month. They are weaned at the age of six or seven weeks and are independent when two months old, when they become active in the vicinity of the nest.

In Great Britain, two litters a year appear to be the maximum, the first litters being born in the spring and the later ones in June or July. In Scotland, there may be only one litter a year, but there is evidence of several litters in some cases. Winter food supply and weather affect the onset of the breeding season.

Apart from man, the greatest enemies of the red squirrel throughout its range are hawks and pine martens. The marten, in fact, is a faster and more nimble climber than the squirrel, which has often to make spectacular leaps from the crown of one tree into the crown of another to escape. In Central Europe, it has been shown that squirrels form a third of the food of hawks. In Britain, predators on the red squirrel include the fox, the golden eagle, stoat, wild cat and pine marten. In Bri-

tain, the American grey squirrel is now strongly established and it has been shown that the red squirrel is unable to recolonise ground held by greys. The red has been displaced by the alien grey in many places and now holds its own mainly in extensive coniferous forests.

Although the red squirrels lay on fat in the autumn and draw on it during the winter, there is no hibernation. They are not affected by cold. It is true, however, that a squirrel will lie up in its nest for a day or two during blizzards or storms of sleet or rain, but it will come out in the trees again, feeding as soon as the weather improves.

It is well known that some mammals and even some birds store surplus food and remember where they have hidden it. In the autumn, which is usually the time of greatest abundance, the red squirrel hides surplus food, usually by burying it in the ground, or in the leaf litter, but sometimes by hiding it in hollow trees. Some squirrels will store a lot of food in one place, but most of them bury it in caches all over the place. Very likely they forget many of them but they remember some of them and it is not unusual to see a squirrel in spring scraping in the leaf litter for food, and it may well be that it is searching for items which it half remembers having buried there.

The **American Grey Squirrel** is found in the United States and Canada, down to Florida, and five subspecies are recognised by zoologists. It was introduced to Britain at different times between 1876 and 1929 and it has since spread from Southern England into many counties of Scotland as far north as South Perthshire.

Wherever this alien species has become established, the native red squirrel has declined, except in mature coniferous forests. Once the red is displaced it does not seem to be able to re-establish itself in areas held in strength by grey squirrels.

The winter fur of the grey squirrel is grey; in summer it is much browner. Even in its winter coat it has brown hair on its spine and some russet on its flanks. Its short ear tufts are usually brown but are sometimes white. The under parts are white throughout the year. Some young grey squirrels are very red and could easily be mistaken for red squirrels.

Grey squirrels are bigger and heavier than red squirrels, measuring from 17 to 20 inches, which includes tail of up to 9½ inches. The weight of squirrels varies considerably because they can put on and take off weight rapidly.

This species breeds twice a year, in the early spring and late summer, but young animals breeding for the first time usually have only one litter that year. The gestation period is forty-four days and the number of young in a litter varies from one to seven. In Britain, the average is three. Summer litters are usually bigger than spring ones. The young weigh about half an ounce at birth. They are weaned at the age of seven to ten weeks and are fully grown at the age of six months.

The main food of the grey squirrel consists of the seeds and nuts of trees like the oak, beech, hazel, chestnut, maple, elm and sycamore, but in mixed woodland it also takes the seeds of pine and larch. Besides this, it takes a wide variety of vegetable and animal food, including young birds, eggs and insects. The food-storing habit is well developed in this species and it makes caches at all times of the year.

In Great Britain, the animal is a forest pest wherever it becomes numerous. It

can destroy young hardwood trees by stripping the bark from the main stem. It also deforms them by nipping off the leader shoots. It will also bark trees to reach the sap, especially in dry weather. In America, which is its natural habitat, it is a sporting animal and it has been estimated that two-thirds of the squirrel population there is killed every winter — half of them by natural causes, including predation. Predators in Great Britain include dogs, cats, foxes, stoats and owls, but none of these is in the least significant. In Britain the grey squirrel is officially classed as vermin and it is illegal to keep one as a pet or for any purpose without a permit from the Ministry of Agriculture in England, or the Department of Agriculture in Scotland.

Although, like the red squirrel, a forest species, the grey spends a lot of its time on the ground and is not afraid to cross open spaces to move from one wood to another. It moves fast on the ground — up to eighteen miles per hour — and it can leap twelve feet from tree to tree. It will invade orchards and gardens, including town gardens, and in the latter has been seen climbing roughcast walls and running along telephone wires. It swims well and will do so when hunted. It will also do so apparently for pleasure.

The nest of the grey squirrel is built of twigs and leaves and placed in a fork of a tree, thirty or forty feet from the ground. It is lined with grass and leaves and has a side entrance. Dreys are usually built in July and later. The grey squirrel will also build its nest in holes in trees and even in bushes. In summer it also builds platforms of leaves on branches.

Like the red squirrel, the grey is active throughout the winter when it exists to a great extent on food which it has buried, or hidden, earlier. Food items may be buried singly or in small groups, and the squirrel finds its stores again by scent. During the winter, it will visit bird tables in gardens to eat the nuts and other food put out there for small birds.

One grey squirrel was observed visiting a bird table each morning and driving away woodpeckers, tits, thrushes and blackbirds which he kept off until he had eaten all the nuts, raisins, seeds and bits of meat that he wanted. Another one was a regular visitor to a bird table when there was snow on the ground. This one carried away walnuts and hazel-nuts across an open field to a wood 150 yards away.

Migrations of grey squirrels have been regularly noted in America, and there has been some evidence of this on a very small scale in Britain. Such movements may be largely due to failure of food supply in an area.

Many species of tree squirrels are found in Europe, Asia and America, and there is a particular wealth of species in the Malaysian Islands, and in the southern part of the Asian continent. To this group belongs **Prevost's Squirrel** whose fur is black, white and red. Because of its handsomely marked fur it is highly popular in zoological gardens, in some of which it has bred. It is found mainly on the islands of Sumatra and Borneo.

A transitional group between the tree squirrels and the susliks is formed by the ground squirrels. As their name indicates, they live on or under the ground. They differ from the tree squirrels in several important characters. First of all they have cheek pouches (the same as in hamsters), in which they store food. Their teeth resemble those of the

tree squirrel but lack the front upper molar; they have tails shorter than their body length and not so bushy as in tree squirrels. On their backs they usually have lengthwise light and dark stripes. Ground squirrels are found in Northern Europe, Asia and North America and are divided into two groups.

A typical representative is the **Siberian Chipmunk,** which measures from 9 to $9^3/_4$ inches in length, including its tail of 4 inches. It is an attractive little animal, striped black and yellow on its back — five black stripes with yellow between. Otherwise it is coloured rusty-yellow with white belly fur. Its ears are rounded and have no tufts on the tips.

This species lives in the taiga of the Far East (with the exception of Kamchatka), throughout Siberia and into North-eastern Europe. Over much of its range, with the exception of Kamchatka and a large part of Europe, it occupies the same ground as the tree squirrels. Its distribution shows that it is an animal of coniferous rather than mixed forests. According to Vinogradov, the Siberian chipmunk lives in the lighter parts of coniferous, or mixed forests, in both lowland and mountain areas. In some parts, it ranges right up to the timber line. It prefers places with ample undergrowth and shrubs, or moraine country.

Siberian Chipmunk

Although it belongs to the ground squirrel group, the Siberian chipmunk is a good tree climber, but it spends most of its time on the ground or in underground burrows. The burrow system is not complicated and the overall depth of the tunnels is usually less then two feet below the surface. From the main tunnel, several secondary corridors branch off. In the animal's actual lair there are as a rule two chambers, one which is used as a nest and the other as a storehouse for food.

Towards the end of May, or in June, the female has her litter of four to six young, in a warmly lined nest. Exceptionally, a litter may number up to ten. Siberian chipmunks breed only once a year, which is a rare occurrence among small rodents.

In September, or October, according to weather conditions, the chipmunk becomes less and less active and eventually retires into hibernation. Hibernation lasts until March or April, according to latitude and the prevailing weather conditions. Thus, the winter sleep is shorter in Southern regions of Siberia and longest in the most northerly parts of its range.

The Siberian chipmunk feeds mainly on the seeds of various trees and grasses, on mushrooms, strawberries and insects. It stores food, sometimes up to a weight of $2\frac{1}{2}$ pounds and wakes up from time to time to eat.

The Russian name of this species is Burunduk, which is a rendering of its most characteristic call — *burun-burun.* This sound is uttered most frequently before a fall of rain. The chipmunk is active by day and reveals its presence by its cries. It has a considerable vocal range, including a penetrating whistle of content. During the mating period, the females have a special call and some Siberian hunters imitate the female's call to attract males within shooting distance.

The fur of the Siberian chipmunk is always sure of a ready market, but is not as valuable as the squirrel's. It is important as a food species to many valuable fur bearers such as the sable, whose distribution is very largely dependent on the distribution of the burunduk.

In Eastern North America, the Siberian chipmunk has a very close relative — the **Eastern Chipmunk.** This species can climb but spends most of its time near the ground among rocks, on boulders, or on fallen trees, or in low branches. Like the Siberian chipmunk it is a burrower and makes its tunnels under the roots of trees, or under rocks. Its burrows are said to differ from those of the burunduk in having a narrower entrance. The burrow of the burunduk is about 1½ inches in diameter along its whole length.

Of the Eastern chipmunk, Hornaday has written: "We come across this beautiful animal almost everywhere in the eastern states. It moves like a flash of brown light and shows its satisfaction by emitting a repeated *chip-chip-chip.* If we stop silently so as to watch the animal, it also stops and looks at us attentively with erect ear flaps. Apart from quick movements of its flanks it remains motionless as if it were stuffed. Every elevation serves it as a fortress, whether stone or wood. It uses everything as cover and finds its way to its shelters through a maze of paths. If pursued by boys, dogs, or beasts of prey, it quickly runs to the top of a fence and flees to its nearest hiding place."

Eastern Chipmunk

In autumn it stores a great quantity of grain and nuts in its burrow, hence its scientific name, *Tamias,* which is a Greek word meaning *Supplier.* On sunny, midwinter days, it will leave its burrow and sit in the sun. It prefers living among rocks to anywhere else and is often called "rock squirrel" in America. Like the burunduk, the Eastern chipmunk is popular in zoological gardens but because of its small size it is often overlooked by visitors.

This species mates in the spring, and five weeks later gives birth to a litter of six or more young. They are blind at birth, open their eyes after one month and are independent at three months of age.

The **Ground Squirrel** is a common rodent and there are several races inhabiting Central Europe, the Balkans, the Ukraine, Asia Minor, Mongolia and

Ground Squirrel

Trans-Baikalia, up to China. It is never found in forests, being an inhabitant of steppes, whether grassy or cultivated, as for example in Czechoslovakia. The western limit of its range is in Saxony where there is a small colony. In Bohemia, Moravia and Slovakia, it is found in all low, warm regions. In warm, dry areas, for example in the Slovak ore mountains, ground squirrels are found at considerable heights, in some places above 3,000 feet. In Yugoslavia, they have been recorded at over 6,000 feet, but always in dry, open places.

In colour, ground squirrels are sandy-grey with indistinct lighter spots. The under parts are rusty-yellow. The forehead and the back of the neck are reddish-yellow. The ground squirrel has strikingly large eyes with a circle of lighter fur which make them even more prominent. Body length varies from $7\frac{1}{2}$ to $8\frac{1}{2}$ inches and tail length from $2\frac{3}{8}$ to $2\frac{3}{4}$ inches. The weight range is from 8 to 12 ounces.

Ground squirrels have been increasing in numbers in recent years, a fact from which European farmers do not derive much pleasure. The animals are gregarious and live in small colonies. In years of high population, the burrow systems are close together. It is an interesting fact that the animals seldom burrow in the middle of fields, they prefer barren places, field ridges, railway embankments, verges and rough pastures. Thus there is little danger of their burrow systems being ploughed up. As a rule, it is easy to tell when a burrow is inhabited because the animals' droppings will be spread all round the entrance. Another indication is the smell, because ground squirrels always urinate at the burrow mouth before entering.

Observers have noted that there is usually less earth heaped round the burrows of ground squirrels than there is outside the burrows of rabbits. This is because the ground squirrels, when digging, carry away a lot of the earth in their cheek pouches and deposit it all over the neighbourhood, and in older books on natural history this behaviour was described as a constant rule. Recent observation, in fact, shows that many ground squirrels are not so diligent and merely leave the earth lying around their burrows.

In winter there are no ground squirrels to be seen. Before retiring in the autumn, the ground squirrel digs a special tunnel or shaft which it leaves as a blind end about 4 inches below the surface of the ground. It blocks up all the original exit holes with earth obtained by the digging of this corridor. In March or April, the ground squirrel wakes up, but before it can reach the outer world again it has to dig through this layer of 4 inches of earth above its head. The actual sleeping

quarters may be eight feet below ground and it is here that the ground squirrel passes the winter.

Grulich, who has studied the biology of ground squirrels closely, gives details of their lives.

"In its burrow, the ground squirrel lines the nesting chamber with dry litter, usually with hay, but also with rags, wool and feathers. Later, (in the breeding season), it extends and renews the old exit holes which were blocked up with earth at the time of hibernation, then it gives birth to its young.

"Young ground squirrels appear at the burrow entrance from the middle of May onwards. In the neighbourhood of the burrow winter and summer cereals have now begun to grow, while on the field ridges good quality meadow grasses, such as wood meadow grass, fescue, yellow oat grass and cock's-foot are past the flower stage. The young ground squirrels enjoy the ripening, sweet seeds of these grasses. They feed much less on the leaves and other green parts of the plants. Later, however, when the grass seeds on the field ridges have become insufficient for their needs (the young animals grow quickly and their appetites with them), the female and her five or more young range over greater and greater distances from the burrow to feed. Eventually, at some distant locality, she drives a new burrow; a simple tunnel leading obliquely down to a depth of 12 to 16 inches. Some years ago, when I and Professor Rosicky and a colleague were studying small rodents, they caught ground squirrels simply by digging up the temporary burrows in which they were hiding.

"In summer, the ground squirrels have to search for food in the fields where their favourite items, cereal grains, are ripening. Here they drive their temporary burrows right in the middle of the fields so that the food is within easy reach. They eat the grain at special feeding places, or feeding benches, where they always leave a great number of empty ears. Besides vegetable matter, the ground squirrels eat a large number of insects, mice and even young birds. In years when their numbers become high they cause immense damage in the fields.

"After feeding on cereal grain, old ground squirrels grow fat, developing under their skin a fatty layer up to half an inch thick. They are now hardly able to squeeze into their tunnels. As a result, the majority of the male ground squirrels begin their winter sleep even before the harvest has begun. The females soon follow the males into hibernation with the result that only young ground squirrels are left in the fields after the harvest."

Earlier essays on natural history stated that ground squirrels store food supplies in their burrows. This is a typical example of how incorrect information is carried over from one book to another without any checking. Five years of research proved that ground squirrels do not lay by any store of food in the winter. Grulich

Spotted Suslik

Leopard Ground Squirrel

writes: "In vain did I look for any store of grain or tubers when digging up fifty-two burrows and Professor Kratochvil did not find a single grain or any other supplies in eighteen ground squirrel burrows."

As a rule, the female ground squirrel breeds only once a year, second litters are rare. However, litters are so big that there can be spectacular increases in the number of ground squirrels in some years with resulting damage to crops.

Owls and other birds and beasts of prey eat ground squirrels; on the ground they are hunted by the stoat and the weasel. The polecat is also a predator. In addition to this, the ground squirrel is hunted by the stork, by the crow and the bustard. But its greatest enemy is man, who kills it by every possible means.

In Europe and Asia, there are other species resembling the common ground squirrel. In Eastern Europe there is the **Spotted Suslik,** which has brown fur on its back, spotted with a lighter shade. It is found in the central areas of Eastern Europe and ranges approximately to the basin of the river Volga.

The **Little Suslik** closely resembles the spotted suslik. It is found in parts of the Ukraine, in the Crimea and the steppes of the North Eastern Caucasus, the lower Volga basin and almost the whole of Kazachstan. Its preferred habitat is feather-grass steppes, but it is often found on the borders of sandy desert and on cultivated steppes. In the latter areas it has spread considerably, causing considerable damage. Both species of suslik are of great importance as fur-bearing animals.

Ground squirrels are also found in North America, where Miller and Kellog list a total of seventeen species. Among these is the **Leopard Ground Squirrel** which is found on the plains of central North America. It is the same size as the common ground squirrel. On its back it has six light and seven dark lengthwise stripes, the dark stripes being dotted with lighter spots.

In some areas the leopard ground squirrel is found in very large numbers and sometimes its population increases to plague proportions. In general, it differs little in habits from the common ground squirrel so it is not surprising that American farmers find it as troublesome as European farmers find its relative, the common ground squirrel.

Marmots, although they do not much resemble squirrels, also belong to this family. Their true relationship is revealed by examination of their interior structure. Only their skulls and the first upper molars are different.

There are many species of marmots. They inhabit Europe, Northern Asia and America, most of them being found on lowlands and plains. However, some species live high on mountains up to the timber line. One of these is the **Mountain Marmot,** which is a large robust animal, measuring 21 to 29 inches in length, plus

its bushy tail of 5 to 6¼ inches. The fur of its back is yellowish-brown to dark brown, the flanks are yellowish-grey and the belly reddish-yellow. It weighs from 6½ to 13 pounds. It is found in the Alps and the Carpathians and in the high mountains of Central Asia up to Kamchatka, possibly also in North America.

The mountain marmot has been closely studied in Europe and much work has recently been done on this species in the Tatra Mountains area of Czechoslovakia — the only part of that country in which it is found. Few people know that these rodents are also found on the Low Tatras. In 1859, Alpine marmots were brought there, and in 1876 they were joined by two pairs of mountain marmots caught in the High Tatras. The introduction attempt was successful and the marmots bred along the whole ridge of the Low Tatras. The steep glacial valleys on the northern mountain slopes suit them. The marmots are, however, much more numerous in the High Tatras (their natural home), which they share with the chamois and the snow vole.

Anyone who wishes to see a mountain marmot must climb to a height of 5,500 to 6,500 feet, and even then the climber may hear the animal's sharp penetrating whistle without ever viewing the caller.

In recent years, zoologists have tried to discover the cause of this whistle and some thought it was produced through the nose. However, it is not whistling in the true sense of the word as the marmot produces the sound from its throat while its mouth is open.

Sometimes, the whistling serves as a warning, sometimes it merely expresses the mood of the animal. Grazing chamois as well as other marmots raise their heads when they hear this sound. If it is repeated several times in quick succession, marmots and chamois cease paying attention to it and go on grazing.

The mountain marmot is an excellent digger and can excavate burrows over thirty feet long and ten feet deep in the most stony ground. Most of the burrows examined by zoologists in the High Tatras had their entrances under boulders and only a few were exposed to view. Some burrows are greatly enlarged inside and the chamber may hold a whole family of marmots during hibernation. These hibernation burrows are referred to as winter burrows to distinguish them from the summer burrows which are shorter and shallower. In the Alps, the animals usually have their winter burrows at lower altitudes but they excavate their summer burrows high above the tree line. It is easy to tell when a winter burrow is inhabited because of the hay scattered about in front of it and the rocks, sods and grass blocking the hole.

The winter sleep of the mountain marmot lasts for more than half the year. Before the onset of winter, the animals feed well and accumulate a lot of fat

Mountain Marmot

Bobak Marmot

under their skin and are at their heaviest just before they go into hibernation. By spring they are weaker and thinner, sometimes so weak that they can hardly stand. As a rule, the whole family hibernates in the same burrow.

The male marmot lives permanently with a single female. At the end of May, or the beginning of June, the female gives birth to a litter of two to six blind young which she suckles for about one month.

The young are well grown before they venture far from the burrow, but later they make long excursions with their mother. They do not reach sexual maturity until the second year of their lives.

According to Somora of the Tatra National Park: "the marmot is a pronounced day animal which sleeps at night in its underground dwelling. In fine weather it leaves early in the morning in search of food. In unfavourable weather, in the case of rain storms, premature snow fall, or high winds, it often remains in its burrow and does not leave it for several days until the weather has improved. It is very cautious when emerging and will not leave until it is satisfied that there is no danger. It has excellent sight and hearing and can see or hear danger a long way off."

Woodchuck

The steppes of Eastern Europe and Central Asia are inhabited by the near relative of the mountain marmot — the **Bobak Marmot.** It lives at high altitudes on mountain plateaux in Central Asia. In the western areas of its range its numbers are decreasing and it has disappeared from many localities altogether. Elsewhere only small colonies survive. This has been caused by the gradual change of the steppes to cultivation, because the bobak marmot is unable to adapt itself to the new conditions. Nevertheless, a major cause in the decline of these marmots is hunting by man, who kills them for their meat and fur.

Rozanov, discussing the economic status of this marmot says: "We must count the bobak marmot among those animals that do not cause any damage to agriculture." Because of this the Soviet Union has been considering the possibility of settling bobak marmots in certain steppe regions.

The **Woodchuck** is a forest marmot, inhabiting the forest lowlands of the United States and Canada.

Another North American marmot is

the so-called **Prairie Dog,** whose voice resembles the barking of a dog. This is a lowland species found on grass prairie where big colonies are the rule.

The best known species is the prairie dog, which is about 13 inches long, including its tail of $2^3/_4$ inches. Its back fur is russet brown with a black bloom; its belly is drab white. This species inhabits the western parts of Texas and Kansas, to the upper reaches of the Missouri river and the foothills of the Rocky Mountains. A single colony may number up to several thousand animals and the burrow systems are close together. In the abandoned burrows of prairie dogs, many other animals find shelter, including the rabbit, owl and certain snakes. The prairie dog has many natural enemies and is hunted intensively by man. It is not surprising, therefore, that its numbers keep on decreasing and it seems likely that immense colonies will soon be things of the past.

Prairie Dog

There is a special subfamily of the Sciuridae whose members differ from squirrels in having a broad fold of skin between their legs. This is called the patagium and is actually a parachute, which enables the animals to cover great distances in gliding flight. The members of this subfamily are collectively known as petaurists. The tail of the petaurists is not connected to the hind legs by this skin fold. It varies in length from species to species; sometimes it is covered with long, shaggy hair, sometimes it has no more than two lateral webs. Petaurists are found all over the Southern Hemisphere, but are absent from most of Europe. Recent investigations have established them in the East Indian islands, Malaya, Indo-China, Burma, Tchay-Wan, Ceylon, India, Kashmir and northwards to China. They live individually, or in pairs, in dense forests and always in the tallest trees.

The largest species of this family is the **Taguan.** It measures about $23^1/_2$ inches from its nose to the root of its tail and the tail is about the same length. Its hind legs are much longer than its forelegs; The hind feet are five-toed and the forefeet four-toed. The skin fold spreads between the fore-legs and the hind-legs and connects in a small fold towards the tail which is very bushy. The upper fur is greyish-black and the belly fur greyish-white.

During the day, the taguan sleeps in hollow trees. It is active throughout the night, moving in the high tops and making great leaps from tree to tree and from branch to branch with its patagium widely spread. It uses its tail as a rudder so that it can, to some extent, change the direction of its flight when it wants to.

Because it lives in high forest and is strictly nocturnal there is little reliable information about its way of life.

The **Russian Flying Squirrel** is smaller than the red squirrel, being about

Taguan

$10^1/_4$ inches in overall length of which nearly 4 inches is tail. The weight of a mature Russian flying squirrel does not exceed $6^1/_4$ ounces. Between its front and hind legs it has a wide skin fold covered with fine hair which is much finer than the fur of squirrels.

This is the only species that has spread into Europe where it is found only in the extreme north: Scandinavia, Finland and Central Russia. Farther east, it is found between the Urals and the forest areas of northern Kazachstan and in Siberia to the Far East.

In Northern Europe, the limit line of its range is continually moving eastwards so that its numbers in Europe are gradually decreasing.

Vinogradov has written of the Russian flying squirrel as follows: "It prefers mixed forests with islands of ash trees, in the holes of which it has its nest at a height of three to four yards above the ground. In the forest steppes of western Siberia, it sometimes keeps to the vicinity of human dwellings and there it will use nest boxes. In European Russia it is found most frequently near swamps and rivers with groves of alder."

The main food of this flying squirrel is the seed of trees and it prefers the seeds of the alder and the birch above all others, but it also takes the seeds of grasses, strawberries, mushrooms and the buds of trees. It eats like a squirrel, sitting up with the food held in its fore paws.

During the day it keeps to its warmly-lined nest and sleeps. If awakened during the day by some disturbance, it moves its sleeping quarters reluctantly and climbs sluggishly into the crown of the tree. When sitting on a branch motionless its colouring matches its background and it is very difficult to see. If disturbed there it will leap from the top of the tree with its skin fold spread and glide towards the base of a neighbouring tree. In this way it can travel distances of twenty to thirty yards. On the ground its movements are clumsy because its parachute hangs down in folds from its sides, making speed difficult.

According to Bobrinsky, the female breeds twice a year, in spring and summer. Litter size ranges from three to six young.

The fur of the Russian flying squirrel is not valuable, being thin and fragile and difficult to process. Therefore the animal is not hunted intensively. However, Vinogradov has reported that a new method of tanning has been discovered which makes the skin more resistant.

IV 1, 2, 3. *Red Squirrel* 4. *Prevost's Squirrel* 5. *Tuft-eared Squirrel* 6. *Siberian Red Squirrel* 7. *Siberian Chipmunk* 8. *Russian Flying Squirrel* 9. *Flying Squirrel-Assapan*

BEAVERS

Family CASTORIDAE

Beavers are robust, square-built animals with a broad head and a longitudinally flattened tail. The root of the tail is covered with hair; the remainder is covered with skin-like scales. The five-toed hind feet are webbed as in the unrelated otter, showing that the beaver is adapted to life in the water. This is confirmed by other characters, such as its nostrils, which it can close at will, and by its dense waterproof coat.

There are beavers in the Old World and the New. They have been treated as separate species (the European beaver and the Canadian beaver), but it is now generally accepted that they both belong to the same species and are merely geographical races, despite certain slight differences between them.

The **European Beaver** measures from 31½ to 39½ inches in length; the tail is about 11¾ inches. It is a very strong animal and weighs up to 66 pounds. The skull of the Canadian race is slightly narrower than the European.

Few wild animals have interested man as much as the beaver over such a long period, and it is frequently mentioned in ancient literature and folk lore. Local names for the beaver in all European languages indicate that it was once widely distributed. It became extinct in Wales in the twelfth century, but probably survived in Scotland until much later, perhaps even into the sixteenth century. In Scotland, it was known as the Broad-tailed otter — the *dobhran - loslethan* of the Gael. In Europe it was hunted for its fur and meat: in Canada mainly for its fur; and in both places was brought almost to the edge of extinction. It is now a rare animal over most of its range.

In North America, the beaver is found from Alaska and Labrador to the Rio Grande. In Europe it survives mainly in northern areas — Norway, Sweden, Germany, France, Poland and Russia. It used to be found in Switzerland, Spain and Holland as well as in Great Britain.

The main responsibility for the near extermination of the beaver rests with man. Besides being killed for its valuable fur and meat, it has been hunted for the secretions of its rectal gland, which were supposed to have miraculous curative powers. Even in the Middle Ages, hunters made a lot of money out of hunting beavers. Man also killed the beaver because of the damage it caused to riverside trees.

In earlier times, the beaver was found in Southern Europe. Towards the end of the first half of the eighteenth century, it had been entirely exterminated in Southern Bohemia, but was re-introduced there

European Beaver

by Prince Schwarzenberg. The imported animals were confined in beaver huts surrounded by a wall. The beavers bred successfully and, in 1804, two pairs were released in open country in an overgrown fish pond, but they escaped from there and disappeared. Four pairs that were released between Rozmberk and the New Rivers bred far more successfully than the others had done in beaver huts, but they soon began to undermine dams and control by shooting was ordered. This turned into general slaughter and the animals gradually died out. The last of these imported beavers was shown in an exhibition in Vienna in 1873, while the last animal in the Rozmberk beaver hut died in 1882.

Nowadays, the European beavers are strictly protected; they are most numerous in the U.S.S.R. where the colonies have been made up with animals brought in from Canada.

European beavers are not fond of living in large groups, the usual unit being a pair, or a family. At the beginning of August, the female has from two to four young which are born with their eyes open. At the age of four or five weeks, the young animals venture out with their mother to eat grass and their tracks can be seen in the riverside sand and mud. Their presence is betrayed also by the trunks of the trees which show signs of having been gnawed, or bitten through. Beaver pathways wind through reed beds and forest and across the sandbanks. The ground is littered with tree trunks, particularly willows, poplars and alders and, sometimes, even oaks. Wood chips, up to 4 inches long and with conical tips, lie scattered round the tree stumps. In pools and lakes the beaver huts protrude out of the water.

The beaver can cause considerable damage. It fells trees merely to reach the branches, the bark of which it eats. Apart from bark, the beaver eats roots and the stubs of water-lilies. Near cultivation, it will enter fields to eat sugar beet, potatoes and corn cobs.

In river banks the beaver excavates a spacious chamber with several exits below water level, and lines it with reeds, grasses and wood-chips. If the water level falls so that the exits become exposed, the beaver closes them with branches and leaf twigs, which it cements with mud and earth. Inside there is often an additional lining of reeds. The entrance to the castle is below water level. Where water is very deep, the castle has to be built even higher. The sleeping chamber is about 30 inches wide and 14 inches high.

Only in rare cases does the European beaver construct dams like the Canadian subspecies. In 1950, which was a year of great drought, the beavers near Wartenburg constructed such a dam which was 16 yards wide, one yard thick and raised the water level by 2 feet. The beaver is able to fell large trees and has been observed cutting down a poplar with a trunk 27 inches in diameter. The Canadian subspecies is, however, the more accomplished dam builder and of this race, Helge Ingstad says:

"Higher up the river I found a dam — a new construction. The beaver could not have been far away as obviously the dam was to regulate the water level where its winter supplies were stored and where the water had to be prevented from freezing down to the bottom. It was a masterpiece of architecture, being built of interlaced branches weighted down with stones and earth and joined together with clay. It is surprising that the beaver is able to accomplish this and to lay the first founda-

tions in the middle of the violent current. However, the dam was not yet sufficiently strong to stand up to a strong spate and it was breached close to the bank, and in many places it was possible to see the beavers working in an attempt to repair such breaches.

"At a small bend in the river I found a construction which, at one side, was directly connected to the bank. Along its top there were paths trodden out by the beavers in the course of their spring building activity. They had carried the earth there and trampled it down to a smooth surface on the roof of the dam.

"In an upstream birch forest they felled trees on a large scale, and all around the ground was covered with felled trees, from 4 to 8 inches in diameter. The ground round the stumps was white with splinters. Footpaths leading to the working site had been trampled in the reed beds. From there the beavers floated wood to their winter food store under the water and to the dam. The beaver always makes the transport of large trunks as easy as possible. In the river he makes use of the currents and in lakes he waits for favourable wind."

Beavers are at home in the water; they are excellent swimmers and can remain submerged for ten to fourteen minutes.

DORMICE

Family GLIRIDAE

Dormice resemble squirrels in habits and general appearance. They have bushy tails and soft fur. They have four toes on the forefeet and four, with a vestigial fifth, on the hind feet. The strikingly large, dark eyes show that the dormouse is nocturnal.

All dormice are smaller than squirrels and have longer snouts. They are found only in the Old World, from England and France to Asia Minor and the Urals. Their habitat is woodland and secondary growth, parks, coppices, gardens and shrubby slopes. Some species are found also in mountains, living among rocks and trees. All are excellent climbers.

Four species of dormice are found in Europe, all of them strictly nocturnal. They can be identified according to the following key:

Dormice with a black pattern on the head:

1. The Garden Dormouse — body length $4^1/_2$ to 5 inches, tail 4 to $4^3/_8$ inches. From its root to middle, the tail is covered with short hair; the remainder of the tail is shaggy and there is a white tuft on the tip. The upper fur is black and the underfur white.
2. The Forest Dormouse — length of body $3^3/_8$ to $3^5/_8$ inches, tail $3^3/_8$ to $3^1/_2$ inches. The whole tail is shaggy and there is no tuft at the tip.

Dormice with no black marking on the head:

1. The Fat Dormouse, or *Glis glis* — body 6 to 7 inches, tail $4^3/_4$ to 6 inches. Colour entirely grey, tail very shaggy. This species is about the size of a small brown rat.
2. The Common Dormouse (Hazel Dormouse) — a small species. Length of body 3 to $3^1/_8$ inches, tail $2^3/_8$ to 3 inches. The whole body is rusty-yellow in colour; the tail is finely furred.

All these dormice are also found in parts of Asia, and the garden dormouse also inhabits North West Africa. In addition to these, there are other species in Japan and Asia, and twenty-one species in Africa.

All dormice hibernate, either in hollow trees or in holes in the ground, and they sleep more than half the year. During hibernation they coil up with their nose tucked into their belly fur and the bushy tail encircling the body.

The **Fat Dormouse,** often referred to in Great Britain by its Latin name of *Glis glis,* is found from Central Europe, and England, south to Spain and the Mediterranean and east to Persia and Turkestan.

This species lays on a great layer of fat in the autumn on which it draws during hibernation. The Romans noticed this and fattened this species for table. They considered it a great delicacy. The animals were installed in *glisaria* and fattened there.

This species eats all kinds of fruit and nuts and in captivity seems to prefer apples to anything else. It will gorge itself on grapes or sweet pears. In the wild state it also takes the bark of willows and plum trees and some insects. It has not been recorded storing food, which would indicate that its winter sleep is unbroken.

Fat Dormouse hibernating

Glis glis is sometimes known as the Spanish Rat. In England, it has been called the Tree Rat, and it has been mistaken for a young grey squirrel. Its fur is greyish-brown with dark stripes on the outside of the legs and there is a dark ring round each eye. Its bushy tail is horizontally flattened and the fur of the underside is shed laterally from a parting down the middle. As a general rule, this dormouse has its breeding nest in holes in trees, but it will readily use nesting boxes. On the European Continent, rock holes are sometimes used and nests have been seen built in branches.

The nest is built of moss, leaves and dry grass. The young, which number from two to seven, are born in the late summer and there is probably only one litter in a year. The size of litters varies from year to year and may be related to fluctuations in the food supply. Sudden increases of population have been noted in Europe, especially in the warm, bush covered regions of the south, but damage is not usually serious. In some areas, however, notably the Balkans, big increases in population can result in very serious damage and in such years *Glis glis* becomes a pest to planters.

In some parts of Europe *Glis glis* is, according to some authors, a considerable predator on young birds and other small vertebrates. On the other hand, some workers have recorded that captive dormice would not take flesh food in any form. Its own predators are legion: dogs,

cats, rats, stoats, weasels, owls and man. In Europe it hibernates in holes in the ground, or trees, sometimes in thatch or lofts. In Great Britain, most animals are caught in houses which they invade before hibernation.

Glis glis is an agile climber and spends a great part of its life in the trees. During the night it is vocal and noisy. In houses its presence is betrayed by the noise it makes when it is moving about in the roof. One European zoologist, who kept *Glis glis* in captivity, has noted that it is a gruff, irritable and even bad-tempered animal, which bites readily, inflicting a nasty wound. When attacked by a predator it will part company with a portion of its tail, as lizards do, or rather with the covering of its tail. The skin peels off from a certain joint, leaving that part of the tail naked. The naked part is afterwards bitten off by the dormouse.

The **Garden Dormouse** is more widely distributed than *Glis glis,* being found as far south as North Africa. Its habitat is broad-leaved forest.

The colour of this species is reddish or greyish-brown above and white below. On its head there is a distinct black stripe across the eye widening under the ear. In this dormouse, as in *Glis glis* and the other species, the tail skin strips readily. Stripping occurs if the dormouse is caught by the tail, but this does not seem to worry it as it will go on feeding after such an injury. New skin and hair cover the tail, but often the dormouse will bite off the naked piece itself.

The garden dormouse is less arboreal than other species and spends a lot of its time on the ground. Its food is also different. Besides seed and fruits, it eats insects, worms, molluscs, young birds, mice

Garden Dormouse

and other vertebrates and invertebrates. Animal food is therefore important to it.

Soon after wakening from its winter sleep, the garden dormouse mates. Some time between the end of May and the end of July, the female gives birth to her family. Litter size numbers two to seven and many females have two litters. The young remain blind until they are three weeks old.

European writers have commented on the savagery of this species and Dr. Weber has recorded that:

"Seven young animals in captivity first bit off their mother's ear flaps, then her tail, then they devoured her, leaving only the fur. Finally the young began to eat each other until only one robust, young male was left."

It has also been recorded that, in captivity, if any dormouse starts its winter sleep ahead of the others, it will be devoured by them immediately.

It has been stated that the garden dormouse is highly resistant to snake venom, but this has been shown to be untrue. It is true, however, that the venom acts slowly, but the bitten dormouse will die after one or two days.

The garden dormouse builds its spherical nest of twigs, grass, leaves and moss in the crowns of trees, in bushes, or in a heap of branches. Sometimes it will use the deserted nest of a bird, or squirrel.

Like *Glis glis*, the garden dormouse enters human dwellings. It also enters hunting huts and recreation huts where it does a great deal of damage to stored foodstuffs.

The **Forest Dormouse** is an attractive animal with a black stripe across its eye, but, unlike the garden dormouse, its tail is shaggy along its entire length, like the tail of a squirrel.

This is the most widely distributed of European dormice. It is found in the mountains of Central Europe, the Alps, the Balkans and in Western and Central Asia at altitudes of over 3,000 feet, but it is also found in lower forests at 1,800 feet. It will enter huts and other buildings in forests in search of titbits. It is very fond of milk and one zoologist found an animal drowned in a milk can. This species hibernates deep down in the earth.

The **Common** or **Hazel Dormouse** is found across Europe from France to Asia Minor and the Urals. In Great Britain it used to be quite common in the Southern Counties of England, but is far less numerous than it used to be. It is absent entirely from Scotland and Ireland.

The common dormouse is a compact little animal, with round ears, prehensile feet, large dark eyes and a blunt face with big whiskers. The upper fur is brownish-yellow, shading off to yellow or cream sometimes even to white on the underside. There is a white patch on the chest. Young animals are more grey than adults. This species, in England, prefers copses, thickets and secondary growth, where there are trees like hazels, beeches and sweet chestnuts. It is also attracted by old hedges which are heavily overgrown. In Europe, it is found in the lowlands and on mountain-sides, and specimens have been caught over 3,500 feet above sea level, in the High Tatras of Czechoslovakia.

The common dormouse builds its nest in the branches of trees and bushes, usually three feet or so above ground level. Kahman and Fritsch found 527 nests in spruces and 232 nests in beech trees, but the dormouse will also build its nest in grass, among blueberries, or in raspberry canes at ground level. It builds its winter nest on the ground beneath leaves or between roots, and retires in October for its winter sleep. The sleeping nest is spherical and about $4^3/_4$ inches in diameter. Before settling down to hibernation, the dormouse blocks the entrance to the nest from the inside.

The onset of hibernation occurs when the temperature falls to 15 to 16° C; the dormouse's body temperature falls to 5° C. during hibernation.

When it wakens in the spring, the dormouse feeds on the buds of trees, on the bark of young shoots, on seeds, beech nuts and acorns. In summer, it eats strawberries, blueberries, raspberries and other fruits. It eats a certain amount of animal food, mainly insects and other invertebrates. It drinks a great deal and captive dormice are fond of milk.

In Europe, the common dormouse breeds twice a year and in England young animals have been found from early summer until September, which suggests two breeding peaks a year. The peaks of breeding on the Continent are June/July and August/September. The gestation period

is 22/24 days; litter size varies from two to seven and the average appears to be three or four. The young are furred about a fortnight after birth and independent of their mother at the age of forty days. They do not breed in the year of their birth.

This species was once a common household pet in England, as it still is in many parts of Europe. It does not bite when taken in the hand. Animals, taken young, soon become very tame and can be carried about in the pocket. One disadvantage of the dormouse as a pet is that it sleeps during the day and is active when everybody is in bed. When eating, the dormouse sits up like a squirrel, holding the food in its front paws. When eating a hazel-nut, it gnaws a hole in the shell and extracts the kernel with its tongue. It has been said that its method of opening the shell is distinctive, but it is in fact very difficult to distinguish between nuts opened by dormice and wood mice.

During its winter sleep, the dormouse lies coiled up with its forefeet tucked under its chin, its hind feet clenched in front of its face, and its tail curled over its face on to its back. A sleeping dormouse can be rolled across a table like a wheel. The winter sleep lasts from October, or November, until April and sometimes two or three young animals will hibernate together.

JERBOAS

Family DIPODIDAE

Jerboas are distinctive animals, more like small kangaroos than rodents. Their hindquarters are disproportionately developed and the hind legs are usually several times longer than the short forelegs. The tail, which is long and cleft at the tip, helps the animal to retain its equilibrium when it is running. When the animal is at rest, the tail acts as a prop. It has a black and white tip which may act as a signalling device. Despite its small size, the jerboa can make leaps of six feet; only the hind legs are used when running or jumping. At a walk, the legs move alternately, otherwise they are used together as in the hare. The forelegs are thin and weak and the jerboa keeps them crossed at its chest when jumping. When grazing, it walks slowly on all four legs. As a rule, there are five toes on the front feet and three on the hind. Like most rodents, the jerboas hold their food in the forepaws.

Some jerboas have smooth incisors and some have them grooved. They have three or four molars in the upper jaw and three in the lower.

Jerboas are found all over Africa and Asia and into South-eastern Europe. In America, they are represented by a single subfamily. They are typical inhabitants of steppes, semi-deserts and deserts, and all have protective yellow colouring. Despite their weak forelegs, they are able to dig burrows, and live in underground holes. During the day, they hide in their burrows, and at nightfall they come out to feed. At night travellers in North Africa often see jerboas in the headlamps of their cars leaping across the roads like kangaroos.

JUMPING MICE AND BIRCH MICE
Family ZAPODIDAE

The following group is the least specialised of all the Dipodidae. While most of them have long hind legs and a very long tail, their posture is not as erect as that of their relatives. The hind feet have five toes, but two of these are vestigial. This group is found in North America, Europe and Asia and comprises the jumping mice.

The **Hudson Jumping Mouse** is the size of an ordinary house mouse. The upper fur, which is short and dense, is dark-brown with an admixture of brownish-yellow. The flanks are brownish-yellow, flecked with black. The underparts are white. The thin tail is one-third longer than the body and tapers into a thinner, elongated tip.

The Hudson jumping mouse is distributed over a large area of North America, from the Atlantic to the Pacific, and from Missouri to Labrador. It inhabits the forest fringes, or areas of dense shrub and swamps. It is an excellent jumper and moves so quickly in the undergrowth that it is almost impossible to catch.

A close relative of this species is the **Szechuan Jumping Mouse,** which is found in the high mountains of China.

The Birch mice of Northern Europe and Asia are more like mice than jerboas, but they have four molars in their upper jaw, whereas mice have only three. There are six species in this genus of small animals, all of them with long, thin tails.

Only a short time ago, a species was discovered in Czechoslovakia, a remnant from the Glacial Period, which deserves special attention. It is the **Northern Birch Mouse.**

This species resembles a mouse and measures from 2 to $2^3/_4$ inches in length. The tail, as a rule, is one-third longer than the body. The upper fur is grey and there is a narrow, black band along the back which terminates between the eyes. The under-fur is lighter in colour.

The Northern birch mouse was first recorded in the Orava district by Kocyan, but his discovery had almost been forgotten until a German ornithologist, examining owl pellets, found the remains of the Northern birch mouse in the pellets of the eagle owl and the barn owl. As a result of this, more extensive investigations were carried out and many Northern birch mice were caught.

The Northern birch mouse is a typical inhabitant of mountains, living near the forest line where the trees thin out. Many of them live in peat bogs above the tree line. Field investigations in Czechoslovakia revealed that the birch mouse was present in the High Tatras, the Low Tatras and in the Jeseniky mountains. Before this it had not been thought that the species lived so far to the west. However, there were further surprises when a German zoologist found specimens in Bavaria. These discoveries have aroused much interest, as hitherto the species had been known only in Southern Europe.

This species is an excellent climber and a field description has been given by a Czechoslovakian zoologist:

"Once I watched one moving about in raspberry bushes in a sunny clearing in the Low Tatras. I watched it for a while,

considering the possibility of catching it alive. The only chance was to jump from the slope I was standing on into the raspberry bushes. I might have succeeded, as jumping mice are not so nimble, but what I did not know was that at that place there was a hole three feet deep with a tree stump in it, so all I obtained was a nice bruise.

"However, I did not want to give up, so I set there about 300 traps baited with raspberries, pieces of bacon and various seeds. In addition, I sank a large number of deep tins into the ground, hoping that an animal would fall into one of them. Every morning, full of hope, I climbed up the steep slope, but in vain. The only result of my work was confirmation of the fact that these mice are very difficult to catch in traps, as most of the specimens in museums and zoological institutes have been caught by hand.

"However, the exception proves the rule, and once I set out with two Berlin zoologists to the Belanske Tatras and caught one specimen in a trap. The trap had not been baited and the animal had released the spring with its foot."

Polish naturalists have found that this jumping mouse feeds on grass, seeds, strawberries and insects. It builds its summer nest in the ground among bilberry bushes, in ferns, or in mouldering tree stumps. It sleeps from October until May in a burrow which it digs itself. It breeds once a year and has a litter of two to six young. Its life span is about three years.

The Northern birch mouse inhabits some of the mountains of Central Europe, Northern Europe (the southern half of Scandinavia and Finland), and eastwards to Trans-Baikalia.

The **Southern Birch Mouse** is more striped than any other species, but the stripes are not sharply defined; apart from the black stripe on its back, it usually has two lighter lengthwise stripes and, sometimes, two dark ones on the rear half of its body. This species has been recorded from Austria and Hungary.

The **Great Jerboa** inhabits steppes and semi-deserts and ranges from the Ukraine eastwards to the Altai steppe and westward into some parts of Europe.

The upper fur of this species is reddish-yellow, the underside is lighter and the insides of the legs are white. The ear flaps are narrow and longer than the head. The eyes are large, dark and expressive. The great jerboa is about the size of a squirrel (from 7½ to 10 inches); the hind legs are four times the length of the forelegs and there are three toes on the hind feet.

The jerboa is shy and timid. When threatened it makes a frantic dash into some hole in the ground. During the day it sleeps in its underground lair.

Several types of burrows have been described — permanent burrows, which have a sleeping chamber and one or two storerooms: occasional burrows, which are

Great Jerboa

Northern Three-toed Jerboa

not very deep ($7^3/_4$ to $11^3/_4$ inches); temporary night burrows, which are short and have an exposed entrance: and winter burrows, which, unlike all the others are more than six feet deep.

From thirty to forty minutes after sunset, the jerboas emerge from their burrows in search of food. They feed chiefly on seeds, underground parts of plants, and sometimes on insects. In some areas, they can cause considerable damage. As soon as the first autumn frosts set in, the animals retire to their burrows and settle down to hibernation.

Jerboas living in the southern deserts are lighter in colour than those of the northern steppes and semi-steppes. Although their fur is of inferior quality, it has a restricted market value.

Egyptian Jerboa

The **Thick-tailed Jerboa** form a separate group. The animals of this group have only three toes on their hind feet and their ear flaps are much shorter. If pulled down over their head, they reach only to the eye. These jerboas live chiefly in the sandy deserts of South-eastern Europe, Asia and North Africa. Related species are found in steppes and clayey deserts, sometimes in sandy deserts.

The thick-tailed jerboa inhabits the vast semi-desert areas of Central Asia and a few isolated areas in the Southern Ukraine. In the Ukraine it is found on feather-grass steppes, which in no way resemble its Central Asia habitat.

The **Northern Three-toed Jerboa** inhabits the sandy region at the south-eastern tip of European Russia. It is found in Kazachstan, Central Asia, Northern Iran, Mongolia and North-eastern China. It inhabits mainly areas of bush-covered sand, where it digs burrows down to a depth of over sixteen feet.

The **Egyptian Jerboa** is the best known of these. It inhabits the whole of North Africa, ranges southwards to the Sudan and Somalia, and into Asia Minor. It is a typical desert animal, frequenting the wildest areas of dry plains, steppes and sandy desert. The Egyptian jerboa is slightly smaller than the squirrel (about $6^3/_4$ inches). Its tail is longer than its body, $8^1/_4$ inches, and there is no tuft at the tip. The upper parts are greyish-yellow in colour and the under parts white. The long tail, which is covered with short greyish-yellow hair ends in a shaggy

brush, which is black and white at the tip. At dusk, when the jerboas come to life, its bright white tail tip plays an important part as a signalling device, just like the white rump patch of the roe deer.

The jerboa is an animal of the sun and is most active in good sunny weather. It cannot stand cold or wet weather, and under such conditions it will remain in its burrow in a deep sleep which resembles the hibernation of rodents.

Because of their long legs, jerboas move at great speed and only a very fast dog can overtake them. Arabs catch them by digging them out of their burrows, or netting them at the exits. Many jerboas are caught each year for food. In captivity they are amiable and easily managed. They tame easily and will breed in captivity if given good treatment and plenty of room to move. The female gives birth to her family in a shallow burrow in a breeding nest lined with camel hair. The usual litter size is two to four young. Under natural conditions, the jerboa lives on the underground parts of plants and a variety of seeds. But, despite the fact that they live in a dry environment and eat mainly tough, non-succulent food, they drink very little.

MOLERATS

Family SPALACIDAE

This peculiar family, adapted to an underground life, has three species whose characteristics have not yet been clearly defined, and there is still some doubt as whether or not there are one or two species in Europe.

Molerats are really unattractive animals with a hairy, cylindrical body and short legs. The head is broad and thick, the forehead flat. The forelegs are stronger than the hind legs and there are five toes on fore and hind feet. The ear flaps are vestigial, and the eyes covered with skin, so that there is no vision. Powerful, broad incisors protrude beyond the muzzle and are the molerat's only weapons.

In Europe, molerats are found as far west as Hungary; elsewhere they inhabit the dry plains and mountainous areas of Eastern Europe and Asia, but they are also found in Asia Minor and in Eastern North Africa. They are the surviving types of a very old group, closely related forms having been known in Europe since the early Tertiary period.

The **Lesser Molerat** is found in Hungary, the Balkans, Western Ukraine, Asia Minor and Trans-Caucasia. It has short flat fur, yellowish- to greyish-brown above and ash-grey below, with white stripes on the rear parts of the belly. The muzzle, chin and the paws are dirty-white. Tough, bristle-like hairs grow over the cheeks and between the eyes and nose. The body measures from 7½ to 9 inches and there is no obvious tail.

The legs of molerats are weak and not used when scraping; only the powerful head is used for burrowing. With their

Lesser Molerat

powerful incisors the molerats bite through the roots of trees and herbs. They push the earth aside with their forehead, and behind them with the brush-like growth on their cheeks.

One Czechoslovakian zoologist has described his search for molerats in the field:

"In 1957, when I set out on an excursion to Bulgaria, I had no experience of molerats and, therefore, I looked for 'mole hills' that would reveal the presence of these mysterious creatures.

"However, in the lowlands, I found nothing whatsoever. Later, in the limestone Pirin mountains, in a wild and rugged area, my attention was attracted by a small kettle-shaped valley where there were plenty of peculiar molehills.

"One day I took with me several traps with the intention of catching some of these 'moles'. However, to my surprise, the opened burrow was not only large enough to hold my fist, there was even more space left. This, of course, could not have been the work of moles. I was very glad, therefore, to be on the track of the molerats that I had been looking for. In many other localities, I uncovered a maze of underground corridors and I found several storerooms with heaps of shoots and roots and with a few green leaves of forest plants.

"Now I felt sure that the dale between forests and rocks must be the home of a whole family of molerats. Of course these animals cannot be caught in the usual types of trap; therefore I returned to the mountain hut where we were staying for more powerful traps, the type used for catching rats. When I returned I found that all the holes I had opened ten minutes earlier had been carefully closed with heaps of earth. Obviously, molerats do not like a draught.

"I opened up new holes and in the corridors I set the traps. I covered the holes with twigs, leaves, and finally with earth, so that the animals should have no reason to complain of the draught.

"Next day, full of hope, I uncovered trap after trap. Not a single animal had been caught, but every trap had been covered with a heap of earth. Next day was the same, although I had covered the burrows and closed them so tightly that not a breath of air could enter.

"This was a very great disappointment. My hands ached from the daily digging in the hard soil, so I tried another method. I made a wide opening in one of the burrows and remained standing there with a sharply pointed stick in my hand. After a while, I saw, at last, a living animal. It put out its nose, tested the air to right and left, then became frightened and disappeared. I did not have a chance to use my stick.

"I opened another burrow a few yards away, and a yard or so from the opening I pushed a twig vertically through the tunnel, leaving one end sticking above the ground. I was assuming that the animal on its way back to block the airhole would touch the twig and make it move; thus I would be warned in the same way as a float warns an angler.

"With my stick, I took up position near the first hole and watched both the burrow and the twig. After about half a minute, the twig moved sharply upwards. I ran to the neighbouring burrow only to find that it had already been blocked with earth.

"I devoted two half days to the hunting of molerats. On the ridges I found a great number of inhabited burrows and stubbornly set my traps, trying every feasible method, in vain.

"It was obvious that molerats, whose eyesight is useless, have an extremely well developed sense of smell and cannot be easily enticed into traps bearing strong scents. On the contrary, they bury such objects without even touching them."

In fertile lowlands, molerats can cause damage to crops. However, as they are not very numerous, the accumulated damage is insignificant. Molerats living in lowland areas are as a rule larger than those living in mountain areas under less favourable conditions.

MICE AND RATS
Family MURIDAE

This is the biggest family in the whole order of rodents and comprises the largest number of species. Rodents of this group can be found almost throughout the world, in tropical and temperate regions, in lowlands, on high mountains and in the far north.

The body structure of the Muridae is very diverse. There are great differences in the shape of the skull and teeth. The family is important from the economic point of view because the great majority of the species are harmful to man's interest, and some of them transmit a number of diseases: Because of their very great numbers they form an important source of food for other animals — birds and beasts of prey.

The family is divided into three subfamilies, mice, hamsters and voles.

To most people a mouse-like animal is a mouse, and many often confuse such types as a mouse and a hamster, but it is not really difficult to identify them. It has to be remembered that a mouse usually has a long, sparsely-haired tail, usually more than half the body length, prominent ears and, as a rule, large eyes. Hamsters, on the other hand, are more robust with short tails and smaller ear flaps and eyes. In the majority of hamsters the tails are covered with dense hair. There is considerable difference between the teeth of mice and hamsters; the molars of mice have roots and are rugged on top, the molars of hamsters usually have no roots and are ground away from the top. In small species, they grow constantly. The tops are not covered with enamel and the grinding surfaces are not rugged.

Subfamily: MURINAE

The following key should help to distinguish the European Species:

1. *Small species, the size of a mouse:*
   The Harvest Mouse — small, rust-coloured or grey, shorter than 3 inches.
2. *Larger species:*
   A. *With eyes strikingly large and protuberant, not smelly. No dark longitudinal stripe.*
      (1) The Common Woodmouse — on top grey or greyish-brown with rust-coloured tint, below whitish-grey — the colour zones not sharply defined. Length of hind feet (measured from heel to tip of longest digit without the claw) about $^{7}/_{8}$ ths of an inch.

(2) The Yellow-necked Mouse — upper fur rusty-grey, under-fur white. Sharp line of demarcation between zones on the flanks: hind legs $^{15}/_{16}$ of an inch. Tail the same length as the body, or longer.

B. *With dark longitudinal stripe on the back.*

The Striped Field Mouse — black longitudinal stripe on back, coloured rust-brown above, white underside.

3. *Small Mouse species:*

The House Mouse — hind leg shorter than $^{3}/_{4}$ of an inch, colouring grey, or rust-grey, lighter on the underside. The colour of the back gradually changes into the lighter colouring of the underside. On the back of the upper incisor there is a notched groove. Unpleasant smell.

4. *Large species: Rat-sized:*

Brown Rat — tail shorter than the body, ear flaps when pressed to the head do not reach the eye. Colouring grey.

The Black Rat — tail longer than the body, depressed ear flap reaches the eye. Colouring mostly black, but often grey as in the brown rat.

The **Harvest Mouse** is one of the smallest of rodents, and certainly one of the most attractive and handsome, as even people who have an aversion to mice will admit. Its body length is 2 to 3 inches and its tail 2 to $2^{3}/_{8}$ inches. It weighs less than one-quarter of an ounce.

Mature specimens are, as a rule, rusty-yellow in colour; young animals are more grey. If we compare a mature mouse with a young one still in immature coat, we might easily think they belonged to different species. The Eastern races of harvest mouse are slowest in growing their russet fur. Harvest mice are widely distributed, from England across Europe into Asia and Japan and are found mainly in swampy areas of rushes and in reed beds. In England, their main habitat in summer is in hedgerows, corn fields, dykes, reed beds and long grass. In winter, they will be found in corn ricks, or in burrows just below ground level. They do not breed in corn ricks.

The nest is of grasses woven into the shape of a ball and built above ground. Many people mistake it for the nest of a bird. It may be placed in reeds, grass, or other herbage, and is covered from above. The single entrance is at the side.

Breeding nests are usually larger than sleeping nests and are very often lined with thistledown.

Three litters in a year are usual and the number of young varies from three to seven. In some years, when weather conditions and food are favourable, numbers can rise steeply. When this happens, the habitat becomes too small and surplus animals move out into the surrounding country. Many of them seek shelter in corn fields and are carried in with the harvest. In some years, the animals breed in corn fields, or rape fields, but these are secondary habitats. The harvest mouse is never found in forests. It is an accomplished climber and a considerable acrobat and in all its climbing movements makes much use of its long tail. It climbs to the top of reeds and corn stalks, but it will take firm hold with its hind feet, release the grip of its forefeet and lean far out towards the next stem.

The main food of the harvest mouse is

seed of wild grasses or cereal crops, but it also takes a considerable amount of insect food. In corn fields, the damage it does is insignificant. Captive animals thrive on a mixture of bird seed with an occasional maggot.

This species is more active by day than other mice and moves about at all hours. When not seeking food it rests in sleeping nests, or underground burrows. It does not hibernate. Where its numbers are high it may spend the winter in human dwellings. Its main predator is the tawny owl, but the evidence suggests that not many are killed by this bird.

At one time, the harvest mouse was widely kept as a pet in England. Nowadays, few are kept as pets and the species is in decline. As a pet, it is highly satisfactory because it becomes tame and confiding and does not smell. Being active at all hours, it can give much pleasure by its acrobatic performances and climbing abilities.

Harvest Mouse

The **Woodmouse,** or **Field Mouse,** is common and widespread, being found as far north as Iceland and in Asia, India, Persia, North Africa and Europe. It is found all over the British Isles, except on the very highest ground, although it has been recorded at 4,000 feet. There are many subspecies, among them three distinct British races, the Hebridean, St. Kildan, and Shetland.

The names woodmouse and field mouse describe two habitats; but neither is complete. Although it is the typical mouse of woodland, the woodmouse also inhabits hedgerows, fields and gardens, and areas of grass and heather, especially where there are no voles. Where there are no house mice it will readily occupy outbuildings and even move into houses. It is found in dry brushland, shrubby areas, parklands and on the outskirts of towns and villages. It will occupy open, dry, forestland, but not wet, dense coniferous forest. On the Continent, it seems to be more prone to enter human dwellings where it can cause a lot of damage in larders and grain cellars.

The main food of woodmice is seeds, seedlings, buds, fruits and nuts, grain, insects and spiders. Snails are also taken. Recent studies of the species in Czechoslovakia have shown that seeds were found in more than 78 per cent. of all stomachs examined; berries in 8 per cent; buds in 3 per cent; grain food in 28 per cent; roots in 7 per cent; fungi in 5 per cent and animal food in 59 per cent. The nature of the food eaten apparently varies ac-

cording to the age of the animals and in some places, at some times, animal food can predominate. They are very skilful at biting through the shells of snails and hazel-nuts. The method of chiselling hazel-nuts is considered by many zoologists to be diagnostic. Where food is abundant, they will lay by stores of seeds and grain.

In general appearance, the woodmouse closely resembles the house mouse, but it has longer hind legs and ears, much larger eyes and a more massive head. The general colour of the upper fur is brown, warmer towards the rump and shading to buff on the nape and head. The underfur is white, or grey-white. On the throat there is often a patch of orange which sometimes becomes a collar, but this is often absent. Young woodmice are greyer than adults and are, therefore, more likely to be confused with house mice.

Male woodmice measure from $6^1/_4$ to $7\frac{1}{2}$ inches in overall length, half of this being tail. Females are only slightly and not noticeably smaller. Adults weigh from half an ounce to an ounce. Distinguishing the woodmouse from the larger yellow-necked mouse is sometimes extremely difficult and is a task for the expert.

Young woodmice are born in all months, from April to October and there are three or four litters a year. Litter size varies from two to nine, but the average is from four to six and this varies with the season. Midsummer litters are largest and average six young. The young remain blind for twelve to fourteen days. Woodmice live in nests in burrows up to three feet deep. The breeding nest, which is built of chopped and shredded grasses may be below the ground, or under a heap of branches or cuttings. When it is underground, it is at the end of a short burrow.

The woodmouse is sprightly, active and an excellent climber. It can move with bewildering speed and leap vertically to a height of one foot or more. In some parts of Europe it is called the jumper. Indoors it will climb on to the top of furniture in search of food, leaving its small droppings there and on shelves.

Although they have many enemies, woodmice form a much smaller part of the diet of mammal predators than we might expect. They are preyed upon by foxes, crows, owls, weasels, stoats and many others. Being almost entirely nocturnal, and inhibited even by bright moonlight, they seldom become the prey of such birds as kestrels. Domestic cats are opportunist predators. In Great Britain, Southern has shown that the tawny owl is an important predator, up to 30 per cent of its food in woodland being woodmice; next on the list come the small carnivores like the weasel and stoat.

In Great Britain, the woodmouse can become a problem in some areas by grazing down winter wheat or digging up newly planted peas.

In captivity, the woodmouse will settle down quite well; it does not always breed and never becomes quite tame. It has to be handled with great care because the skin of the tail will strip away in the fingers. The bared portion thereafter falls off.

The **Yellow-necked Mouse** has a yellow spot, or stripe, on its throat, a marking which is found on many woodmice. In the yellow-necked mouse, the tail is the same length as the body, or longer. A yellow-necked mouse weighs from $^3/_4$ to $1\frac{1}{2}$ ounces. The eyes of this species are exceptionally large and the eyeball is ·5 per cent. of the body weight, whereas

in the house mouse the eyeball makes up only ·13 per cent. of the body weight.

The yellow-neck is a more accomplished jumper and climber than the woodmouse.

Sometimes the yellow-neck builds its nest high up in a tree or in a nest box, an abandoned squirrel nest or in a tree hollow. As a rule, however, it is built on the ground between tree roots, under fallen trees, in brushwood heaps, between stones, under wood piles, or in holes in the ground. In Great Britain, trapping has revealed that the yellow-neck occurs in small communities in large populations of woodmice. Their habitats are similar and the yellow-neck will take up residence in apple orchards, greenhouses, dwelling houses and even in bee-hives. In Europe, the yellow-necked mouse is more truly a forest animal than the woodmouse, which tends to keep to the forest edge and the surrounding fields.

The food of the yellow-neck is similar to that of the woodmouse, but it is said to prefer the seeds of oil plants above all others. Stomach analysis of yellow-necked mice in Europe has shown no trace of green food, the entire contents being of solid, pulpy substances. The yellow-neck stores seed and grain in the autumn, sometimes in human dwellings. It requires, or takes, much more animal food than the woodmouse. In forest it can cause considerable damage by gnawing off the cones of spruce and pine, opening beech masts and acorns, or stripping the seeds from lime, maple and other trees. In some years, the yellow-necks increase to near plague proportions in European forests and can be heard rustling and squeaking all over the place. A very high proportion of the forest seed harvest is eaten by the yellow-necks at such times and so these plague numbers probably affect forest regeneration to a considerable extent.

Like the woodmice, the yellow-neck is a nocturnal species, becoming active about one hour after sunset. It can, however, be seen about during daylight. It is a considerable traveller when foraging, as can be seen from examining its tracks in snow. These show that individual animals will travel many hundreds of yards from their burrows. The breeding season of this

The relative sizes of House Mouse, Harvest Mouse, Striped Field Mouse, Yellow-necked Mouse, Woodmouse

species is more extended than that of the woodmice, the first young being born in February.

This species is easily kept in captivity, where it thrives. It can be kept along with the common woodmouse, although there are records of the larger animal attacking the smaller one. In both species, the skin of the tail strips readily.

The distribution of the yellow-neck is within the range of the woodmouse. It is found over almost the whole of Europe and Asia, but becomes rare towards the south in both Continents. In Great Britain, it may be much more common than is generally realised.

The **House Mouse** is a real cosmopolitan, but did not achieve its world-wide distribution unaided. Its original home was probably Western Asia, whence it spread to the rest of the world by human agency. Formerly an inhabitant of the open steppe, where it still lives an outdoor life, it has become in most other parts of the world the companion of man, living in his buildings and dwellings and at his expense. In houses it is not a welcome lodger because it gnaws at almost everything it finds, soils everything with its droppings and urine, and leaves an unpleasant odour behind it. We call the house mouse a commensal of man, which means simply that it shares his food and lodgings, although as an uninvited guest.

In the Far East, the house mouse can still be found living on dry steppes. Once it associates with man its feeding habits change and new types arise which have longer tails and darker bodies than the original. This is the type we find in Britain. Wherever there are human beings the house mouse will try to move in, so they are abundant in houses and warehouses, and about farms, where they infest corn ricks. The house mouse is, in fact, the mouse of the corn ricks. In summer, numbers of them can be found breeding in hedgerows and fields near farms, but it is quite likely that they are an overspill from corn ricks and that their numbers are maintained from there.

In the best habitats — that is where there is abundance of food and shelter at all times — the house mouse will breed throughout the year, and this is true of indoor populations or mice living in corn ricks. But animals living under field conditions produce fewer young in winter time. There is much variation between one habitat and another. Laurie has shown that mice living in corn ricks will produce up to ten litters a year, while those living in town buildings or out of doors will produce about five. In corn ricks, two or more litters will sometimes be found together in communal nests. The young mice are weaned at about the age of eighteen days and can breed in their first year. In some years, mice numbers increase to such an extent that they become a real plague. This has happened in Australia and the United States of America.

The indoor populations have their nests in holes, under floors, in garrets, woodsheds and walls. Any suitable material is used for building the nest — paper, rags, feathers, leaves, wood and straw. The mice can gnaw through wood and mortar.

House mice are mainly nocturnal but are also active by day and their daytime activity probably varies according to how hungry they are. The mice feed over a small area which is shared. Crowcroft, who has studied captive wild mice, discovered that males will live with two or

more females and defend their territory vigorously against other mice. Where numbers are high master mice will hold territory, while lesser animals hold none and are not allowed to breed. Mice living in corn ricks will move out in summer and back in winter. These mice can double their numbers every two months.

The house mouse is highly adaptable; it can even live in refrigerated warehouses, where meat is stored at a temperature of minus 10° C. Dr. Fraser Darling has told how house mice moved into his camp on an uninhabited island where they had been living out of doors for eighty years.

The house mouse takes a wide variety of food and indeed will eat anything of vegetable or animal origin. Outdoor mice will eat grain but not much is known about their food there. Chitty and Southern have shown that mice in a corn rick can consume up to 16 per cent. of the grain. Whatever their diet, mice appear to need very little water.

Mice living in houses become very bold and will often come out in search of food in the presence of human beings and in good light. Fortunately, they are easily trapped and the common spring-trap, baited with a piece of bacon or cheese or toasted bread, is the quickest way of dealing with them. The domestic cat is of course a specialist predator, but cannot always reach the mice in a house. Mice living in corn ricks are preyed upon to a very great extent by barn owls, which also live in association with man. Weasels will enter corn ricks to hunt mice and they kill a great many.

The size of house mice varies considerably, but an average animal will measure up to 3½ inches long, plus a tail of about the same length. The face is sharp and slender, and the general colour greyish with lighter underparts. Mice in Western Europe have longer tails and greyer bellies than those in Eastern Europe. In fact, the tails become shorter and the under-fur lighter in colour as we travel eastwards. Weight varies from half an ounce to three-quarters of an ounce.

The **Brown Rat,** like the house mouse, is now found in most parts of the world, having been transported by man from its original home in Asia. It was still absent from many parts of Europe as late as the eighteenth century. As a stowaway on board ship from Norway, it reached England in 1732 and North America in 1775. The rats were able to climb from shore to ship and from ship to shore by the long mooring ropes. In the British Isles, its arrival meant the beginning of the decline of the Black Rat, an earlier immigrant from the East.

The exact place of origin of this rat is not known, but it is assumed that it came from those regions in Eastern Asia where it still lives a completely field existence. There, the brown rats still live in extensive swamps, far from human settlements.

In Great Britain, as in other parts of the world colonised by them, rats have become a major problem. They cause

Brown Rat

damage, not only by eating foodstuffs, but by fouling them, thus spreading dangerous diseases. Rats living in sewers, canals, cellars and rubbish dumps will invade food stores, human dwellings, stables and cowsheds. In some sub-tropic and tropic areas, the brown rat can spread bubonic plague.

Where its numbers are high it can even drive out people. It is a matter of record that the people of North Rona died when rats, coming ashore from a wrecked ship, devoured the island's meal store.

Trapping, and the old methods of poisoning, were of little avail in rat control, but some modern baits have had spectacular success. At a farm, for example, the whole population quickly comes to feed from meal containing the bait, and the entire farm can be cleared in this way. There is, however, now some evidence that rats resistant to these baits are now repopulating areas which had been cleared. Elton has shown that while cats cannot reduce a population of rats, they can prevent reinfestation of a place that has been cleared of them by other means.

A fully-grown adult brown rat will measure from 14½ to 19½ inches in overall length, of which the tail will be 6½ to 9 inches. It is a much bigger and stronger animal than the black rat and a typical adult will weigh about one pound. Weight varies however with sex and age. Because of the length of its under-fur, the brown rat always appears bristly and is obviously much shaggier than the sleeker black rat. The tail of the brown rat is never as long as its body, whereas the black rat's is longer than its body.

No animal is more adaptable and it will be found from sea level to the tops of mountains and from the sea-shore to the very heart of the countryside, inhabiting houses, factories, sewers, rubbish dumps, farms, sewage works and slaughter houses. Many rats make seasonal movements, for example from farm buildings to nearby streams and hedgerows in summer, and back indoors in winter. Rats summering in the open will often use the burrows of water voles and rabbits; hence they are often confused with water voles and imagined to interbreed with rabbits. In fact, rats and rabbits do not interbreed.

The length of the breeding season and the number of young born in a litter vary with the nature of the habitat and the abundance of the food supply. Rats living in the best habitats, for example in rick-yards and farm buildings where they have a constant food supply and permanent cover, will breed throughout the year. Others living in less favoured habitats will breed for part of the year. But, even in the best habitats, the female rats do not breed all the time, nor do they all breed at the same time. The number of litters in a year varies from three to five, according to conditions, and the number in a litter from two to fourteen. The biggest litters are born in the best habitats.

The young rats at birth are blind and naked, but they mature quickly and are able to breed at the age of three months, which means that they are producing litters long before they are fully grown.

Rats eat, damage, or destroy, all sorts of stored foods. They also take carrion, birds, eggs, small mammals, green plants, seeds and insects. On the shore, or on uninhabited islands, they will eat crabs, fish and dead birds. On islands where there are sea birds, the rats will eat the eggs and chicks in the breeding season.

They take advantage of every activity of man which produces an item of food: thus, they are found on poultry farms, pig farms, and arable farms.

Despite the host of predators living at its expense, the population of brown rats in Britain remained high until modern poisons were developed, but as we have said the rat now appears to be adapting to these. Predators include dogs, cats, stoats, weasels, foxes, otters, eagles, buzzards, herons and owls. Foxes, stoats and barn owls, in particular, are great killers of rats.

But a big, powerful rat is not an easy prey for an inexperienced predator and will face up to cat or terrier or stoat if given the slightest opportunity to defend itself. A cornered rat will face, and even attack, a man. The bite of a rat is severe and can be highly dangerous.

Stephen and Lockie have described encounters between large rats and terriers of which the following are examples:

"There was the rat we found on the shelf in the meal store, looking as big and bristly as a hedgehog. When we closed the door he squealed defiance from the shelf and launched straight at our faces. He landed behind some sacks of grain and squealed from there. The terrier, trying to force her way through the sacks, was bitten twice on the lips before she broke through and killed him. He was 18½ inches from tip to tip and weighed 1¾ pounds.

"There was the other rat, whose pelvis she chopped when he was three feet up the wall in the barn. He fell to the floor and pivoting on his seat, faced her, gnashing his teeth as she circled. For one reckless moment he turned to squeal defiance at the men. Then the terrier made a frontal attack and killed him. A cat in a similar situation would have been in trouble. The cat's style is stalking and ambush and it might give way to a big rat, forewarned, full of fight and waiting for the assault."

Preyed upon by many species, the rat itself preys upon many others, including nestlings, game chicks, poultry chicks, ducklings, and baby rabbits in their nest. A rat in a brooder house will kill every chick within reach. It is, therefore, the greatest single enemy of the poultryman and the game preserver.

It is also an agent in spreading trichinosis, equine influenza, and the disease of the human liver known as leptospiral jaundice (Weil's disease). It is therefore obvious that man is completely justified in waging war against this alien species in every possible way.

Although it is wasteful and destructive, the rat is also a food hoarder. It will carry away grain and other food to a cache, or caches. It will also store hen eggs, rolling them away with its nose and chin and heaving them over obstacles with its fore paws. Rats have been observed stealing eggs from under a broody hen at night.

As is well known, the brown rat is highly suspicious of strange objects on its territory and any strange object appearing suddenly on a runway will be carefully examined. Once the rat has accepted it, it will travel round it. The detour then becomes such a habit that the rat will continue to make it, even after the object has been removed.

The female rat makes her nest of any suitable material she can find — rags, paper, straw, hay, string, rope or nylon. If the nest is disturbed she will carry away her young, or lead them off if they are big enough to follow. In defence of her

family, she will face man, dog, cat or stoat, and fight to the death.

The **Black Rat,** originally an inhabitant of the Far East (Indo-Malayan region and South China), began its spread in the Middle Ages, reaching most of the world as a stowaway on ships. This was the species responsible for the Black Death, which wiped out such a large part of the population of England. It is still a carrier of bubonic plague, especially in the tropics.

The general colour of the black rat is slate, the upper fur being darker than the under-fur. The fur of the back is long and silky and sometimes the animal has a white spot on its chest. The black rat is a smaller-bodied species than the brown and more delicately built. Adult males measure up to 18½ inches in length; the females are smaller. The tail is more than the length of the body. There are three colour phases of this rat found in Britain — the standard type, which is black above and grey below; one which is agouti above and white below; and one which is agouti above and greyish below. In black populations, grey-brown animals appear in the same litter as blacks.

Like the brown rat, the black will breed throughout the year in the best habitats, with the biggest litters arriving in summer and autumn. There are from two to five litters in a year numbering from four to eleven young, depending on food supply and living conditions. The gestation period is twenty-one days. The young are weaned at the age of twenty-seven days and can breed at the age of three or four months when their weight is about 2½ to 3 ounces. They continue growing while breeding and when fully adult will weigh about seven ounces.

Black Rat

Since the arrival of the brown rat, the range of the black has been shrinking and, nowadays, it is found mainly in the top stories of buildings, docks and warehouses. It is the most common species on ships and it is very likely that the British population is constantly being made up by immigrants. In recent years, however, immigration has been falling off because of the stricter inspection of ships in port. In America, the black rat is also found in sewers and cellars, and in some parts of Europe it lives in trees. These rats are, in fact, accomplished climbers and can travel along power lines and cables.

While there is no doubt that the black rat has been losing ground since the arrival of the brown at the beginning of the eighteenth century, and that the brown will kill the black, competition with the brown is not the only factor in the black rat decline. Dr Jirsik considers the ousting of black rats by the stronger and tougher brown to be a secondary cause and says:

"On the basis of literary sources it is very easy to follow the gradual disappearance of black rats in Europe towards the end of the nineteenth century, as well as their new gradual spread after World

War I and, more particularly, after World War II. As regards Bohemia it has been stated that as early as 1871 the black rat had been completely exterminated. The cause of this may be considered to be, above all, the gradual disappearance of wooden buildings. My observations have proved that rats prefer wooden buildings, store-houses and mills. It has been shown that the black rat has persevered in regions where wooden buildings have remained the most common type."

The increase of black rats after the war is discussed as follows:

"In Czechoslovakia black rats are being spread chiefly by means of river transport in the rivers Elbe and Vltava, and also by lorries serving mills on the banks of these rivers. In the ports of the Elbe we can sometimes see rats running along the gutters on the roofs, even in bright daylight. The black rat was introduced to Bohemia from Germany entirely by river transport on the Elbe. At Lovosice, I saw black rats leaving the ships by way of the mooring ropes."

In Britain, apart from those living on the island of Lundy (where they are found on the sea-shore), the black rat inhabits the high areas of buildings, mainly in urban areas; while the brown rat inhabits ground level all over the country. The design of dockside buildings has been much improved since the war, making it more difficult for black rats to gain access. Bentley considers that the decline of the black rat will continue in Britain, but that it is unlikely to become extinct as the docks of London, Bristol and Liverpool will provide it with strongholds for a long time to come.

The black rat will eat almost anything in the way of food and can be a major pest where fruits, seeds and cereals are stored. Like the brown rat, it fouls as much as it eats, or more. Where it lives in trees it can also be a pest by stripping bark.

In urban areas, the main predator on the black rat is the domestic cat. In rural areas, it is killed by owls and beasts of prey.

HAMSTERS, VOLES, LEMMINGS, ETC.

Family CRICETIDAE

Like mice, the hamsters have uneven molars with roots. Unlike mice they are robustly built and this appearance is emphasised by their short legs and their short, thick tail. They have cheek pouches in which they can store food.

The **Common Hamster** measures from 4½ to 13½ inches in length, plus a tail of 1½ to 2⅜ inches. Hamsters are attractive little rodents with handsome fur which is yellow-brown on top and black on the underside. The sides of the muzzle are reddish-brown and there is a stripe on the throat of the same colour. On the cheeks there is a large yellow spot and the muzzle is whitish. There is, however, much variation in colour.

The common hamster inhabits France and Central Europe, eastwards of the Yenisey. It is found only in level country.

The old belief that the hamster is a grumbler and an irritable and bad-tempered animal is correct. One zoologist has written:

"Once I was given an attractive little hamster. It seemed a very charming little animal. I carried it about in my pocket and it would climb up on to my shoulder. I could play with it as though it were a toy. However, this did not last long. Once, when I put my hand in the pocket where I carried the hamster, it immediately bit through my finger. After that it was impossible to make friends with it. It seemed to realise that it had a most effective weapon which it could use at will. From that time I could not touch it without the protection of thick gloves and when it was fully grown it could bite even through these, so I had to stop playing with it altogether. It had changed completely from a friendly young animal into an adult biter. In its cage it either fed or slept, and when disturbed it snarled angrily. Then one day it escaped from the cage and ran about my study. It got between the wall and the wardrobe and during the night it gnawed a hole in the back of the wardrobe. With the splinters it built a nest which it lined with pieces of torn paper.

Common Hamster

"It was indeed a hard job to catch this hamster as it snorted and spat at me and attacked fearlessly if I put my hand near it. I appreciated its courage but my patience was exhausted. At last I succeeded in getting it into a cucumber bottle and took it away in my car with the intention of releasing it in the country. On the way, however, it escaped from the bottle and ran about the car. When I tried to catch it, it bit me in farewell greeting. I released it or, rather, it escaped into a field of ripening corn. Since that time I have refused to take hamsters as presents."

It is interesting to note that hamsters live only in fields which have a deep layer of topsoil. Most of them are therefore found in fields where they can burrow down to a depth of six feet without any difficulty.

The hamster's living chamber is connected with the outside world by an oblique exit and a vertical entrance. A second chamber serves as a store-house which in winter will hold an average of 30 pounds of corn, potatoes, beetroots and other food. In one of the corridors a small area is set aside as a latrine. In the living chamber the hamster has its nest, which is lined with grass and in which it spends most of its life.

In the first half of October, when the cold weather has set in, and food is becoming short, the hamster retires into hibernation, blocking the holes connecting its sleeping chamber with the outside world. If the winter is mild, the hamster will sometimes venture out of doors for a short period on mild days. In any event, it wakes up at intervals during

the winter to eat from its supply of stored food.

Male and female hamsters occupy separate sleeping chambers; those of the females have several vertical entrances. The males take no part in caring for the young, and the females, being fully occupied with their families, have little time in which to accumulate large supplies of food.

The hamster is an excellent digger and uses its front paws for the work. If it encounters a tough obstacle like a tree root, it uses its teeth. As it digs it pushes the earth behind it with its hind feet.

The hamster can often be seen sitting up on its hind legs holding food between its fore paws and eating. In this position it also washes itself. It is also the hamster's defence posture.

When feeding, the hamster fills its cheek pouches, moving its head from side to side as though swallowing with great difficulty. If surprised by an enemy, it rapidly empties its pouches and takes up its defensive position.

Soon after they awake from their winter sleep the males join the females and live with them for a short period. Violent fighting now breaks out between rival males. After the brief mating period, the pairs separate again and each partner returns to a solitary life.

The gestation period in hamsters is twenty days, and litter size varies from four to eighteen young, which are blind and naked at birth. The young grow rapidly. Their eyes open after fourteen days and they are independent at the age of twenty-five days. Up to three litters are born in a year and in some years the fields are swarming with these rodents.

In years of high populations, the hamsters cause a lot of damage. They eat almost everything that is growing in the fields — green crops, cereal grains, clover, lentils, peas, beans, beet, turnips, potatoes, onions, cabbages, fruit, strawberries, etc. They also eat animal foods such as small birds and small mammals.

Because it can be such a pest, the hamster is usually killed on sight. Its fur is useful, being fine and durable and suitable for the lining of coats. In some countries people eat the meat, which tastes something like rabbit. Some people consider it a great delicacy.

After World War II, the **Golden Hamster** became well known. It is now widely kept as a pet, although originally it was used only in laboratories. To-day it can be obtained in every pet shop. It is popular with children because it is easily kept and breeds readily in captivity.

The golden hamster is a close relative of the common hamster. It was originally described by Waterhouse as early as 1839 in Syria. Thereafter it was forgotten about and one hundred years had to pass before its existence was again confirmed. Had it not been for two specimens kept in alcohol in the British Museum, Waterhouse's description might have been forgotten about entirely. In 1930, a zoologist, named Ahorni, managed to obtain a female with twelve young and succeeded in breeding golden hamsters in captivity. The offspring of this single family reached England in 1931. From England, specimens were sent to America and in 1945 others reached Germany. Now the golden hamster is one of the commonest pets kept throughout the world.

In West Germany, this species has become feral. In the field it spends the winter in burrows which it digs for itself. So far, it has not spread from there, pre-

sumably because the Central European climate does not suit it.

The **Norwegian Lemming** is brightly coloured. Its body is bright yellow-brown. From the nose to the shoulders there is a wide black stripe, interrupted above the eyes and ear flaps by two yellow stripes. On the back there are usually indistinct dark spots. The fur of the underside of the body is lighter than the upper. The body length is 5 to 6 inches. The tail does not exceed $^3/_4$ of an inch in length.

The range of the Norwegian lemming extends from the high mountains of Scandinavia, northwards to the lowland tundra of the Kola Peninsula via Finland. In the Swedish and Norwegian mountains, the lemming inhabits the highest mountain ridges, most frequently in the zones of stunted birches and, exceptionally, in the upper limits of coniferous forest.

The Norwegian lemming hides under stands of stunted birches, among rocks, or interlaced roots, and in carpets of dense moss. Its surface creeps are very intricate in pattern. The lemming builds a spherical nest of bitten grass stems and foliage, just under the surface of the ground. Summer nests are always well hidden among tree roots, or moss, or under rocks, or rotten tree stumps. Winter nests, spherical in shape, are built under the snow, and these are exposed on the surface in large numbers after the snow has melted in the spring. The number of such nests is an index of the number of lemmings. Large numbers of them are washed away by water during the spring thaw. In normal times, lemmings are not often seen. They escape observation because they are nocturnal and live so much under cover, or under the ground. They do not lay in food stores and are active throughout the winter.

In their general behaviour, lemmings resemble hamsters, being quarrelsome, not only amongst themselves but in their relations with other animals. They will offer resistance to many of their enemies, including dogs. When angry, they hiss and snarl.

Lemmings live mainly on plants.

Normally, lemmings breed three or four times a year, the average litter size being from five to six, but cyclical fluctuations, with peaks every four years, are typical of this species. Then the lemming population explodes. Such population explosions appear to be connected with weather conditions and food supply as well as being related to increases in the numbers of other rodents on the same ground. However, the actual cause of such increases is not yet known.

In years of high population, lemmings migrate and this phenomenon has often been described in books on natural history. Migrations actually start before food shortage becomes noticeable in areas of high population, which means that food shortage is not the prime cause. The lemmings leave their home range in large numbers, moving down to lower altitudes and appearing in places where they do not normally occur.

This fact was noticed by Olaus Magnus as early as 1567 and he explained the phenomenon simply by saying that the lemming "had rained down from Heaven". Migrating lemmings travel chiefly at night and appear unexpectedly in the streets of towns and villages where they have never been seen before. It is not surprising therefore that people often explain their sudden arrival by various superstitions. Now we know for certain that the cause of the migrations is ex-

cessive population. At normal levels of population, lemmings do not migrate; they live settled lives on their home ground.

Migration has catastrophic consequences for the lemmings, most of them perishing when swimming across rivers or in the sea; the survivors are decimated by birds and beasts of prey. Finnish zoologists report that, during these migrations, thousands of drowned lemmings are washed ashore from sea and rivers. Even the tundra is sometimes covered with the bodies of lemmings that have died of disease or exhaustion.

It has long been noted that in years of lemming increase, the numbers of their natural predators increase proportionately; for example, polar foxes, ermines, wolverines, snowy owls, kites, et cetera. At such times, these predators are well supplied with food and thrive. On the other hand, herbivorous rodents, such as voles, suffer from want of food, as the lemmings graze up everything. This scarcity of food sometimes becomes so serious that rodents devour the dead of their own species. Birds and beasts of prey assemble in regions swarming with lemmings. Other species, for example elks and some species of wildfowl, leave the area altogether because they cannot stand such a concentration of lemmings, and sometimes several years elapse before these species are able to return to their former range.

Migration, following on excessive numbers, is not confined to the Norwegian lemming. It has been recorded in other species in North America and more especially in Northern Asia.

The **Siberian Lemming** is one of these. According to the old records, this species migrates in compact masses, all heading in the same direction. When they reach a river barrier they throw themselves in blindly. When they reach the sea they leap from the shore into the water and perish. Such behaviour has not been recorded for a long time however, and we know about it only from old reports.

In fields, or on forest paths, we often come across the dead body of a vole, or we may even find the bodies of different species. Some species are very harmful to man's interests; others are pests on one part of their range and not on others. Below we give a key to the identity of voles, omitting only the musk rat which is easily recognised because of its great size and its laterally compressed tail.

A. The Water Vole. The hind leg longer than $^{7}/_{8}$ of an inch. A large vole living most frequently near water, but in autumn also in fields, gardens, etc.

B. The Bank Vole. Hind leg shorter than $^{7}/_{8}$ of an inch, coat colour reddish or rust-brown. Usually found in forests or heavily overgrown banks. Tail dark above, light on the underside.

C. Voles. Grey or greyish-brown on top.

1. *The Snow Vole* — hind leg $^{3}/_{4}$ of an inch. A large grey vole with remarkably long whiskers, found in mountains above the forest line.
2. *The European Pine Vole* — a vole with markedly small eyes and ear flaps hidden in its fur. On the sole of its hind feet are four fleshy warts (in other voles, six). Tail short — 1 to $1^{1}/_{4}$ inches. Hind feet about $^{5}/_{8}$ths of an inch.

3. *The Common Vole* — grey or greyish-yellow vole, hind feet with six warts. Hind leg $^5/_8$ to $^3/_4$ of an inch long. Lives in open country in drier localities.
4. *The Field Vole* — a dark-brown vole, hind leg longer than $^3/_4$ of an inch. Lives in moist localities with thick undergrowth. Most often in swamps, rough grasslands, or young coniferous forests.

The **Water Vole** is found over the whole of Europe, and in Asia to the River Lena. It is a large vole about $5^1/_8$ to $7^1/_2$ inches long with a comparatively long tail measuring 3 to 5 inches in length. The general colour is dark-brown, but light-grey and black individuals are common. In the north of Scotland, water voles are generally very dark in colour. This species is frequently mistaken for the brown rat, because brown rats regularly invade water vole burrows in spring and summer and the two species may be found along the same stretch of a river or stream.

In Great Britain, the water vole is found mainly on the banks of slow-running streams or rivers, or in ponds and canals where the water level remains fairly constant. In the Scottish Highlands, it will be found up to 2,000 feet. In the British Isles, it is rarely a problem animal. Its burrowing rarely undermines river banks and the damage it does to field crops is insignificant. It does, however, eat the bark and twigs of trees. In Europe, damage can be much more serious, partly owing to its burrowing habits and partly because of its depredations on field crops, especially potatoes. Continental gardeners and planters consider it a major pest. There, the animals often settle in for the winter in an orchard or nursery. They dig in between the roots of trees and then bite off the roots. The first the grower knows about it is when the young trees begin to lean sideways in the wind. When he pulls them out he finds that the roots are no more than gnawed-off stumps. Trees with only a part of their roots destroyed will keep on growing, but the growth is slowed down.

In Europe, the water vole can also be a considerable forestry pest, destroying a number of hardwood trees. In fields it eats root crops, especially potatoes and beets. Nothing approaching this level of damage takes place in Great Britain. In Great Britain, the main foods of the water vole are grasses and reeds growing by the waterside, but it also eats wild garlic, iris roots, beech mast, roots of many plants and stubble grain from the fields near the water's edge. Animal food consists of water snails and mussels. The voles are preyed upon by stoats, weasels, otters, herons, owls and pike. The American mink, which is now feral in many parts of the country, is a new predator.

Water voles store food in underground lairs and under bankings, especially pieces of twigs, reed stems, roots, tubers and green leaves. The animals are very fond of carrots and this is the best bait for enticing them into a trap. Voles will graze grass on the top of bankings within quick reach of a bolt hole specially driven to a feeding area. If surprised when grazing, the vole will withdraw into the bolt hole, or dive into the water. It is a first-rate diver and swimmer.

Water voles breed from March to September, or October. Litter size numbers four or five young and there may be four or more litters in a season. Litter size varies with the season, also with the size and age of the mother. First litters appear

in May and the young from these are soon in breeding condition. Litters born later in the year breed in the following spring.

The **Bank Vole** is widely distributed in Europe (with the exception of the extreme south), in Western Siberia, Asia Minor and Trans-Caucasia. In some forest areas of Europe it is the most numerous mammal and the most serious pest, whereas in Great Britain the field vole is the major pest of young plantations. In Britain, the bank vole rarely becomes a problem to the forester.

This species in Britain prefers deciduous woodland, or slopes or bankings with plenty of ground cover. It also inhabits hedgerows, where grass and creeping or trailing plants grow thickly. So long as there is plenty of ground cover it will often be found far from trees and has been recorded at 2,500 feet in Scotland. In Europe, it lives in forests or in small groups of trees.

The Bank vole is more mouse-like than the field vole. Its upper fur is chestnut-brown, its under-fur light-grey, or buff. It has small eyes and its ears are partly hidden in its fur; the tail is dark above and light below and is half the length of the body. Body length varies from 4 to $4^1/_4$ inches and the tail up to $2^1/_2$ inches. Island races of this species are heavier and bigger than animals from the mainland.

The breeding season is from April to October, but there is some out-of-season breeding in certain years. Several litters are reared each year and litter size varies from four to seven young. The young when born are naked and blind. Their eyes open after twelve days and in three weeks they are self-supporting. Under

Water Vole and Common Vole

favourable conditions young females will reach maturity at the age of one month, but few bank voles survive to breed for a second year. The nest of the vole is built above or below the ground and is made of moss, grass and bark, all finely shredded. Nests built above ground are usually in thick cover or in mossy tree stumps.

Bank voles eat the leaves and stems of plants, berries, roots, seeds and fungi. But they also take insects and their larvae. They will eat the body of a field vole and are sometimes cannibals. They are said to take fewer insects than woodmice eat. Wrangel found that bank voles would eat birds' eggs, young birds, young frogs, earthworms, locusts and even carrion. He also found that cannibalism was common. More work needs to be done here as the discoveries of other zoologists do not agree with Wrangel's.

The bank vole is an accomplished burrower, driving its tunnels just under the surface, with entrances and exits linked by surface runs. From these it is sometimes dug out by foxes and badgers, but weasels are the only predators capable of travelling through the burrows. The bur-

rows are also frequently used by other voles and sometimes by shrews.

The **Snow Vole,** with the chamois and the marmot, is a typical inhabitant of the mountains of Europe. It is found in the Pyrenees, the Alps, the Carpathians and the Balkans. Its range extends to Asia Minor and the Lebanon, and farther eastwards it is found in the Caucasus and South-west Turkmenia. It inhabits the rugged areas above the tree line and is most often found in rock crevices, screes, mountain debris and glacial moraines, and leaves its rocky cover only when it comes out to feed on succulent mountain plants.

The snow vole is well adapted to its life in the high cold of the mountains, being protected by soft, thick, greyish-brown fur which has a bluish sheen. Its whiskers are longer than those of any other species of vole. These whiskers are tactile organs which help the vole to find its way about when moving in dark underground places. Because they do not leave their cover except when feeding, snow voles are not often seen, and their presence is usually betrayed by the heaps of droppings to be seen on flat stones under overhanging boulders.

The snow vole measures $4^1/_2$ to $5^5/_8$ inches and its tail is from $1^3/_4$ to $2^5/_8$ inches long.

One of the commonest and most widespread voles is the **Common Vole** which often reaches spectacular plague numbers and whose population fluctuates on a four-year cycle. At the peak of each cycle, the voles increase to a density of many hundreds per acre in fields, meadows and the edge of forests. In a plague year their burrows honeycomb the ground and it is impossible to walk over an infested area without seeing voles scurrying about everywhere. A maze of surface runways, trodden out by a constant passage of voles, links burrow with burrow. Corridors, or creeps, run through the tussocks and thickets and form an intricate network.

The enormous increase in the number of voles has its effect on their predators. They invade the infested territory in ever increasing numbers, until, at the peak of the plague, they are thick on the ground — kestrels, buzzards, owls, gulls, herons, storks, crows, magpies, shrikes, weasels, stoats, polecats, hedgehogs and foxes — all preying on voles and very often nothing but voles. Weasels and stoats multiply. Short-eared owls rear large families. Predation is constant, yet makes no impression on the teeming voles.

Following the peak of a cycle, the voles begin to die off in large numbers. This is the beginning of the downward curve of the cycle and when it reaches bottom zoologists use the term *crash.* When the crash comes it is not brought about by the predator force which has been living at the vole's expense; as suggested by Chitty and other workers, it is due rather to loss of viability as the result of overcrowding — in other words, to sheer nervous and physical exhaustion.

Formerly, it was thought that the vole crash came about as the result of epidemic disease — a view which has never been confirmed. In fact it now seems quite clear that it comes about due to debilitation and collapse following on overcrowding. The first symptoms of the end are a general sickliness, cramp, disturbance of equilibrium and loss of alertness. The voles begin to crowd together as

their body temperature falls. A thorough examination of animals in such a doomed population revealed a striking falling off in the sugar level of the blood. It is, of course, almost certain that unfavourable weather and failure of food supply play some part in bringing about the decline. After the crash, the fields and meadows seems almost empty of voles, and the survivors now begin to breed, increasing steadily in numbers until the next explosion three to four years later.

Although not much is known about the reason for such population explosions, the vole's capacity for increase can be clearly demonstrated. One Hungarian zoologist kept a pair of common voles in captivity and in the period from 2nd March to 23rd December, that is within ten months, this pair and their offspring of three generations had produced 2,557 animals — 1,597 males and 960 females. Under natural conditions, such a rate of increase would be considerably reduced, as many of the voles would be killed by their natural enemies as well as by disease, weather, food shortage and other causes. But even allowing for all this, it is quite obvious that voles can reproduce more quickly even than butterflies, some of which lay from 200 to 300 eggs a year.

Voles mature quickly, the young coming into breeding condition at the age of thirteen days, that is while they are still being suckled by their mother. Many of them become pregnant before they are weaned at the age of seventeen to twenty days. As the period of gestation lasts for nineteen to twenty-one days, young females can produce their first family on the thirty-fifth day of their lives. Older females mate again immediately after giving birth to a family, which means that litters may follow one another at intervals of three weeks at the height of a successful breeding season. Only deterioration of the habitat, or disease, can slow down or interrupt this trend.

The average number of young in a litter is four to six, but family size varies from four to twelve. The weight of a litter at birth is very high compared with the mother's own body weight and in fact makes the common vole a record-holder. Whereas in domestic pigs the weight of a litter amounts to 10 per cent. of the body-weight of the sow, and in the case of a small bitch dog, 30 per cent. of her body-weight, the weight of the common vole's litters may be as high as 53 per cent. of the body-weight of the mother. What this reproduction rate requires of the female vole's organism can be appreciated fully only if we realise that during her pregnancy the mother is also suckling the young of the previous litter and that the milk consumed by them amounts to one-quarter of her body weight.

Of course the high reproduction rate of voles is largely influenced by food supply and the quality of the environment. Animals in the best environments, with the best of food, fare better than those in poorer environments where food is scarcer.

Recent research has discovered another interesting detail in the biology of this species. The young of most mammals leave the nest as soon as they are grown up, after which they settle in the neighbourhood or disperse. Voles do not behave in this way; only the young males become restless and leave the vicinity of the nest. The young females, on the other hand, form with their mother something like a nesting association with joint littering and suckling.

Common voles prefer green food which is rich in vitamins and proteins — for example, tender shoots, lucerne and clover — therefore the largest concentrations occur in clover and lucerne fields. There, besides abundance of suitable food, they find plenty of shelter from their enemies as such fields are not ploughed every year.

In years of peak population voles can cause serious damage to agriculture, whether arable or grassland, and man kills them on a large scale. Killing usually begins, however, when the animals are multiplying towards their peak and then it is already too late. Control has to be attempted while the numbers are still low. But killing by man and predators does not really solve the problem and the most effective weapon that can be used against voles is subsoiling and deep ploughing carried out in time. This destroys the runs and burrows of the voles and drives them out. During this dispersal many die. It has of course to be understood that the common vole is mainly an animal of agricultural land and managed grassland and can therefore be affected by such techniques. One thing is certain — expensive measures carried out after voles have reached their peak achieve nothing.

The common vole is a grey rodent, from $3^1/_2$ to $4^3/_4$ inches in length. Its tail measures from $1^3/_8$ to $1^5/_8$ inches. It is found throughout Europe, with the exception of Great Britain, Scandinavia and some parts of the Mediterranean area. It is also found in Asia, Asia Minor and Iran (Persia). It is a typical inhabitant of cultivated steppes and is able to adapt itself to the most diverse conditions of life; thus it will be found by roadsides, railway tracks and well into mountain areas. It has been found in high regions, and on the tops of mountains where the weather is seldom warm. It is not found on the same territory as the short-tailed vole and the two species have not been recorded together. Many European zoologists consider that the field vole was the original inhabitant of much of Europe but was pushed out by the smaller, but more vigorous, colonising common vole, with the result that the common vole is the typical vole of agricultural ground and the field vole more typical of rough grasslands, young plantations, peat bogs and swamps.

The common vole is not found in Great Britain, but there are races on two of the islands, the Guernsey Vole on Guernsey, and the Orkney Vole on Orkney.

The **Short-tailed Vole,** or **Field Vole,** is a more northerly species than the common vole. Where the ranges of the two species overlap they are found in separate habitats, the common vole as we have already seen preferring cultivated areas. In North America there is a species closely related to the short-tailed vole of Britain. A number of subspecies have been recognised in Britain, but it is by no means certain if their status is justified. At the moment, subspecies are recognised in the islands of Gigha, Islay, Muck and Eigg; and in the Scottish Highlands; in the Hebrides, and North-west Highlands; and England with the Scottish Lowlands. There are no short-tailed voles in Ireland, nor on the Isle of Man, Lundy, the Scillies, Lewis, Barra, South Rona, Rassay, Rum, or Orkney.

In Great Britain, the short-tailed vole is found on rough grasslands where the cover is thick. Young plantations provide ideal habitats and in such places voles

V 1. *Garden Dormouse* 2. *Common Dormouse* 3. *Norwegian Lemming* 4. *Forest Dormouse* 5. *Fat Dormouse* 6. *Birch Mouse* 7. *Harvest Mouse* 8. *Golden Hamster* 9. *Yellow-necked Mouse*

can reach plague numbers in peak years. Other habitats are heather-moor, marginal grassland and alpine plateaux, for example in the Cairngorms. Grass is the main food of this species as well as its main cover, so it is found in greater or smaller numbers wherever these conditions occur. In scrubland or woodland, short-tailed voles are scarce. They are uncommon on cultivated ground except perhaps in hay fields in years when the hay is late in ripening.

Although this species is not such a serious pest as the common vole, its numbers fluctuate in the same way and in peak years can reach plague level. Classic examples of plagues in Britain are provided by the outbreaks of 1875/76 and 1891/92 in the south of Scotland. Their numbers became so great there that the sheep had nothing to eat and had to be hand-fed, even in the summer months.

As in the case of the common vole of Europe, predators move into an area where there is an explosion of short-tailed voles. Specialist predators on voles are weasels, short-eared owls, kestrels and hen harriers, but other species such as foxes, pine-martens and wildcats will kill large numbers at such times. When the voles become scarce the predators disperse, and the former balance between voles and predators is restored. The principle food of the field vole is grass; they eat the best and most succulent grasses when these are available, but in winter will take less palatable varieties as well as bulbs and the bark of trees. They prefer the bark of hardwood trees to that of conifers.

Short-tailed voles show great variation in size and weight, the overall length varying from $4^3/_4$ inches to $6^1/_4$ inches, of which $1^1/_4$ inches to $1^4/_5$ inches is tail. The tail is little more than one-quarter of the length of the head and body. Weight varies with season, feeding, and the number of voles on the ground. A big male at the peak of condition will weigh $1^1/_2$ ounces, but in winter adults are more likely to weigh less than one ounce.

The breeding season in this species extends from March to September, or later, and sometimes goes on through the winter. The gestation period is twenty-one days and young voles can breed at the age of three weeks, but they may not breed at all in a peak year.

The number of young in a litter varies from one to eight, but is more likely to be three or four, up to six. The vole makes her nest of dry grass which she shreds with her teeth. It is built in a tussock or under roots or fallen trees. Any board or sheet of metal or asbestos lying on the ground is sure to attract voles, and nests are commonly found underneath such items.

In Europe, the short-tailed vole is a common inhabitant of swamps and the banks of waterways as well as of wet forest, where its presence is betrayed by heaps of chewed grass and rush stems. Where the soil is not too wet it builds underground nests, but where the water level is high it builds spherical nests of grass in reeds, in timothy-grass and in tussocks.

The short-tailed vole becomes very tame in captivity and is easily kept. As a general rule, it does not bite when held in the hand but a newly caught wild vole will sometimes do so.

The smallest species is the **European Pine Vole,** which is from $3^3/_8$ to $4^1/_8$ inches in length, plus its tail of 1 to $1^1/_8$ inches. Its fine fur is greyish-brown, or grey-

ish-black. It has very small eyes and its ears are hidden by the fur.

The pine vole inhabits Europe from France to the Caucasus and Asia Minor. It is much commoner in some parts of Europe than was previously thought and in the mountain forests of Czechoslovakia it is now known to be plentiful. The pine vole prefers moist areas with a good herbage cover and soft black soil. It is a burrower and little heaps of earth excavated by the vole are found at every entrance hole to the tunnels. Although the pine vole prefers shady and cool habitats it avoids swamps. On low ground it occurs only in small isolated colonies so it does not become a pest in agricultural areas.

The European pine vole is thought to be exclusively vegetarian, as captive animals have never been observed eating animal food. The usual number of young in a litter is from one to three, but in mountain areas, under favourable conditions, local populations can sometimes reach high densities.

The **Musk-rat** is a giant vole, measuring from 2 to $2^3/_8$ inches in length including its tail of about one inch. The long tail is almost naked and is vertically flattened. The original home of this species was North America, but it has been introduced into Europe, Japan and the U.S.S.R., where it is farmed for its fur which is the musquash of commerce. Inevitably many animals escaped and succeeded in building up large feral populations, which do great damage to river banks. It was imported into the British Isles in 1929. Very soon, escaped animals built up colonies, notably in Central Scotland and in Shropshire (smaller ones became established in Surrey, Sussex and Ireland), but all were exterminated by intensive trapping.

The musk-rat quickly became acclimatised in Europe and is now as well established there as the grey squirrel is in Britain. It is highly adapted for its life in the water, the feet being heavily overgrown with strong bristles and the toes being partly webbed. The long fin-like tail acts as a rudder and an oar. The fine hair is absolutely waterproof and the animal can close its ears during diving or swimming.

The upper fur of the musk-rat is chestnut, or dark-brown, lighter on the flanks. The belly fur is pale grey, sometimes with a yellowish tinge and very soft.

Feral European musk-rats have been measured and weighed by Dr. Kratochvil. In a series of several hundreds he found that the heaviest animals weighed from $2^1/_2$ to 3 pounds and measured from 12 to $13^3/_4$ inches in length, excluding the tail. From other parts of Europe, specimens weighing $3^1/_4$ to $3^1/_2$ pounds have been recorded and in Germany one was caught weighing 5 pounds, a most exceptional specimen.

In Europe, as in its homeland, the musk-rat builds "houses" of aquatic vegetation and drives great burrow systems into the banks of rivers. Although its reed houses are obvious enough and easily found, few people succeed in observing musk-rats in the wild. Anglers, sitting patiently by the riverside, probably see more of them than most people.

In its original home the musk-rat ranges from Alaska to Louisiana, and several races are recognised by zoologists. In America it has been hunted since ancient times by the Indians for its meat, and by white hunters for its rich fur. White people have an aversion to musk-

rat meat because the animal so closely resembles a mouse. Many millions of musk-rats have been killed in North America for the fur trade.

The history of feral musk-rats in Britain followed that of Europe, except that many parts of Europe were successfully colonised and escapes were on a much larger scale.

When Count Colloredo-Mansfeld introduced the musk-rat to Bohemia he could not possibly have foreseen the consequences of his act. In 1905, he imported ten pairs of musk-rats from America and put them in a fish pond near Dobris. The conditions there were ideal for them, the climate suited them and the pond, densely covered with aquatic plants, provided them with ample food. They multiplied rapidly and soon spread into the neighbouring countryside. Within a few years they had overrun Central Bohemia, and by the beginning of World War I had spread through the whole country and beyond. Heated arguments arose as the result of this spread. Most people considered the musk-rat a "terrible pest", with the result that merciless war was declared against it. At the same time, it was described as a fierce enemy of fish and a destroyer of dams which it was said to undermine. The musk-rate, therefore, has not been classified as game and can be hunted at any time of the year. Other Europeans consider all this a pity as it has been shown that the damage caused by the musk-rat is not serious and in fact the animal is considered an extremely valuable fur bearer. More than 50,000 pelts are sold each year in Czechoslovakia.

From Europe the musk-rat spread across the frontiers into European Russia. There its value as a fur-bearer was appreciated, and in later years it was introduced into many other parts of Russia. By 1940, almost 40,000 musk-rats had been settled in different parts of the U.S.S.R. These animals were brought from Czechoslovakia and Finland. To-day, the musk-rat is found over large areas of the U.S.S.R. and is now spreading into Mongolia and China.

After 1920, some farms in Western Europe bred musk-rats imported from America. Some animals escaped and established colonies in a number of places, and many people claim that the introduction of the musk-rat to Europe was on the whole a good idea as many Europeans can now afford musquash coats.

The musk-rat lives almost exclusively on aquatic plants, eating leaves, stems and roots, at which it gnaws under the water. On the banks among leaves and timothy-grass, the animal treads out its runways. In the wintertime it has to seek its food under the ice and its movements can be followed by the air bubbles escaping from its coat as it swims. In spring, the results of this winter activity can be seen when the stems of reeds and bulrushes, whose roots had been eaten in

Musk-rat

winter, float up to the surface. Few people realise that the great heaps of aquatic plants they see, sometimes forming islands of green, are the work of musk-rats.

During the winter, the musk-rat spends much time in its house but does not hibernate. In Europe, the animals have, as a rule, two types of lair. One of these is a wide chamber, maybe over thirty feet long, which is hollowed out at the end of a tunnel in the bank. Here the musk-rats live and bring up their young. In winter these lairs are almost all deserted and it is then that the animals build their houses, which are actually heaps of reeds and rushes, or twigs. These houses, built in the water, are strong enough to support the weight of a man. There is no obvious entrance and the house has to be taken apart before the living-room can be seen. From the base of this several escape corridors lead to the water.

Sometimes a house will have two living chambers and sometimes the musk-rat will live in its reed house throughout the year and rear its young there. Why some animals should do this nobody knows. Zoologists in Bohemia have reported that musk-rats in a waterfowl reserve took over wooden huts built on piles in reed beds. The huts were put up to discover if wild ducks would nest on them. In the spring, not one of the twenty huts could be seen. The musk-rats had covered all of them with reeds and settled in them.

Musk-rats begin to breed after the spring thaws, usually some time in March. The gestation period is from twenty-one to twenty-three days. There are three to four litters a year, and on the average seven to eight young per litter. After the age of four months, females can breed in their first year if they have reached a weight of $1^1/_2$ pounds. However, in the majority of such cases, the offspring do not survive the winter.

In Czechoslovakia musk-rats are widely hunted so that a very old animal is a rare occurrence. During his investigation Dr. Kratochvil found that only 10 per cent. of musk-rats killed in the spring had lived for two winters; 2.5 per cent. had survived three winters, and fewer than 10 per cent. were four years old. Where musk-rats are abundant, as in Southern Bohemia, many people make their living by hunting them, but not all of them hunt sensibly or by approved methods. Some hunters kill the animals all the year round, taking young animals, pregnant females and nursing mothers indiscriminately. Many zoologists there feel that musk-rats should be protected during the breeding season as hunting at this time is neither profitable nor economically sound. The summer coat is not nearly so valuable as the winter one. Until now, no action has been taken to abolish uneconomic exploitation of musk-rats.

One method used by hunters, who are known as rat-catchers, is "prodding". A wire net, or cage, is placed at the entrance to a burrow, then the ground is prodded with a pointed iron rod. The experienced hunter can tell when the iron rod is penetrating a tunnel. Once he has located this he prods along the length of the tunnel until he reaches the sleeping chamber. The musk-rat bolts and is caught in the net or cage. If there are several musk-rats in the lair, the hunter can catch them all and such a catch will bring him more money than many people can earn in a week. An inhabited burrow is usually betrayed by the muddied water at its entrance.

Occasionally, the musk-rat will nibble at a dead fish and this has given rise to

the unfounded complaint that it is harmful to fisheries. It is true that musk-rats do take some animal food. They hunt and devour crayfish and will bring ashore live shellfish, the remains of which can be found on their feeding platforms.

It is often said, that the musk-rat causes serious damage by burrowing into dams. But in large fish ponds with strong concrete dams, no damage whatsoever can be done. More serious damage may occur in small ponds with dams built of earth. Nevertheless, the extermination of the musk-rat would result in considerable loss in revenue to Czechoslovakia. For the time being, however, the species is not in danger and is still abundant in many parts of the country.

THE SPRING-HAAS

Family PEDETIDAE

In their general appearance this family, the spring-haases, resemble jerboas, but in other ways they differ from them considerably. While their forelegs are weaker than their hind legs, they are still stronger than the forelegs of the jerboas. The tail is shaggy but the greatest difference between the spring-haas and the jerboa is in its teeth. In each jaw there are four molars with two protuberances. In his monograph on rodents, Ellerman mentions only two species of spring-haases, both of them inhabiting South Africa.

The **South African Spring-haas** measures $4^3/_4$ inches including its tail of $2^3/_8$ inches. In general colour it resembles the hare. Its ears are of medium length and it can press the edge of the ear flaps together, thus completely closing them. As the animal spends the greater part of its life underground, this device prevents earth and sand from entering its ears.

The spring-haas digs deep burrows and some observers say that it is well nigh impossible to dig one out. On the other hand, it is easy to shoot animals from a suitable shelter set up in the middle of a colony. Like most rodents, the spring-haas lives in colonies. Its meat is said to be very good.

The spring-haas is undoubtedly the best jumper among rodents. Normally it moves in short jumps, but when pursued it can set up records for the long jump. It has been known to make leaps of ten yards, which is about the distance covered by the much larger kangaroo. Such a tremendous performance is all the more outstanding if compared with the jump of a hunted stag, which in exceptional cases, may clear a ditch eleven yards wide.

South African Spring-haas

COYPUS, HUTIAS, ETC.
Family CAPROMYIDAE

This group of robust rodents is found only in Central and South America.

The **Coypu,** or **Coypu-rat,** is an inhabitant of the milder regions of South America. The name, coypu, was given to it by the Chileans. It is an unattractive animal, resembling a huge, hairy, brown rat. The body length is from $15^1/_2$ to $23^1/_2$ inches and the tail from $15^1/_2$ to $19^1/_2$ inches. Old males reach a weight of nearly 13 pounds. It is a strong, robust animal with powerful, prominent, orange-coloured incisor teeth, which give it a ferocious appearance. The coypu has short legs with five toes on each foot. On firm ground it moves slowly but it swims well and is very active in the water. The hind feet are webbed. On firm ground the animal moves slowly, almost seeming to drag its belly on the ground. The tail is sparsely haired, the muzzle blunt and adorned with strong whiskers.

In South America, the coypu is found mainly by flowing waters. It burrows in clay bankings, constructing its tunnels in such a way that the water level reaches halfway up the entrance hole. The tunnel then slopes upwards so that the living chamber is dry and above water level. Observations on captive animals have shown that the coypu will excavate tunnels up to twenty feet long, but in the wild state it appears to be content to dig them only three or four feet in length. Where the coypu cannot excavate a tunnel in a bank, it will construct a nest of reeds. It does this by twisting reeds together and weaving them into a sort of basket. Above this basket it bends other reeds so that the nest is covered from above. If the water level rises, the coypu will build a new nest on top of the old one, so that after a period they may be several storeys. In South America, the coypu is hunted for its fur and its meat. The fur is of considerable value, being the nutria of commerce.

Coypu

Nowadays, the majority of coypu hunters shoot the animals. A swimming coypu, with almost the whole of its back showing above the water, is always an easy target. The South American cowboys, the gauchos, catch the animals with long, hooked spears. Trained dogs are often used to point the coypu when it strays from the water in search of food. Some dogs are able to catch a coypu in the water and carry it ashore. The most brutal way of catching them is by trapping, because the animals are often caught only by a leg and usually drown. Another objection to this method is that young animals, whose fur is not very valuable, are also caught in these traps.

As the demand for nutria is always considerable, the coypu has become a rare animal in some areas. Strict measures had

therefore to be introduced for its preservation, and some South American countries have completely prohibited the hunting of coypu by any means. The seller of nutria must now produce a certificate issued by the police confirming that he obtained it legally.

However, it appears that not even the strictest precautions will save the coypu from extermination. Poachers and hunters pay no attention to the law, with the result that farms have had to be established in South America for the breeding of coypus. These now supply nutria skins and live animals to Europe. In 1932, there were one hundred coypu farms in the Argentine; by 1938 there were 1,100 farms.

In Europe, the coypu is bred on the ranching principle, and sometimes animals escape from captivity. These escapees usually fall victim to hunters, some of whom then imagine they have killed a beaver. In Great Britain, the coypu has become established in some parts of England, the animals being the descendants of escapees from fur farms.

In the U.S.S.R. a number of experiments have been carried out in an attempt to establish coypu colonies under natural conditions. It seems, however, that the hard Russian winter does not suit the coypu, so a system of "half-wild breeding" has been established in many places. This means that the animals spend the summer in freedom in some isolated water basin, or in a pond or a lake with abundant aquatic vegetation. Before the onset of winter they are caught up and kept at special farms. The warm climate of Trans-Caucasia suits the coypu well and there it has increased to such an extent that its numbers have to be controlled by shooting. According to Novikov: "the coypu has no specific breeding season". This applies to the U.S.S.R. as much as to South America. In the U.S.S.R. acclimatised females have young at all months of the year, including winter.

Litter size varies from one to eight young, which suckle their mother for thirty-five to forty days, but they begin nibbling at green food on the first day of life. Coypus feed mainly on leaves, stems, stubs and the roots of aquatic plants, so their requirements are modest.

In Great Britain, the coypu is now quite common on the Norfolk Broads where its numbers can sometimes make it a serious pest to agriculture. The animals will travel up to one mile in search of food such as sugar beet, kale and green cereals. Grazings also suffer at times. In the Norfolk Broads, the coypu keeps the waterways open by eating the vegetation, but it also upsets the habitats of other animals by flattening the ground cover. It also damages reeds which are harvested for thatching.

One of the close relatives of the coypu is the **Hutia-congy.** It is a robust animal and although seemingly clumsy is a good climber, able to move at considerable speed in the branches of trees. The hutia-congy inhabits the thick forest stands of the island of Cuba. It measures from $17^3/_4$ to $23^1/_4$ inches in length, its tail being 6 inches. Mature animals weigh up to $17^1/_2$ pounds. The meat is considered good eating and the natives catch the animals whenever they can.

When climbing, the hutia-congy uses its tail as a supporting limb.

AFRICAN MOLERATS
Family BATHYERGIDAE

At first sight, molerats resemble the Spalacidae and were formerly classified with them. However, modern zoologists have a different opinion and these burrowing mammals are now considered to be more closely related to the porcupines. However, even this classification is not yet finally agreed upon. In the case of this group there are no fossil ancestors to tell us anything about their previous history.

The molerats live in the eastern part of Africa, south of the Sahara, and their range extends to Cape Province. They are more highly adapted to an underground life than the Spalacidae.

The **Sand-mole** is the largest of the family and measures about $11\frac{3}{4}$ inches in length. It is an unprepossessing animal with a cylindrical body, no external ears, and eyes which are hardly visible. The short legs, which barely protrude beyond the fine, woolly fur, have broad feet with scraping claws. The most striking feature of this animal is its long protruding incisors, which appear to grow directly out of the muzzle instead of the mouth. The sand-mole prefers loose sandy soil in which to excavate its wide-branching network of tunnels. It lives on vegetable food and can be a pest in cultivated areas in Cape Province and Kenya.

If the sand-mole is unprepossessing, the next species is even more so. This is the **Naked Molerat,** which is unique among rodents in being almost hairless so that it resembles a wrinkled white sausage rather than an animal. Only a few scattered bristles adorn the animal's wrinkled skin and tail. The tail is about half the length of the body.

Naked Molerat

The body is slender and the head flattened like that of a lizard. The eyes are insignificant, being no more than pinpoints.

There are no external ears. The strikingly large protruding incisors appear to grow out of the animal's face. Whereas the toes of burrowing mammals are usually short and strong, the naked molerat has long, slender toes, ending in long claws. It is about the size of a mouse.

This species lives permanently underground and nobody has ever seen one alive in daylight. Having weak forelegs it lives only in loose soil in areas where the network of plant roots provides it with plenty of food. It must be highly resistant to heat as it continues burrowing even at noon when the African sun raises the soil temperature to 50° C.

Unlike the mole, the naked molerat does not put up any mole heaps. It has its own method of removing the excavated earth, which Phillips has described as follows:

"This little animal, called *farmufer* by

the Somalis, excavated here and there whole groups of miniature craters, looking exactly like volcanoes in activity. When at work these little animals transport the excavated earth to the bottom of these craters and heave it up with great strength and rapid movements. The animals themselves never appear."

The naked molerat inhabits Ethiopia, Somalia and Kenya.

OLD WORLD PORCUPINES

Family HYSTRICIDAE

Porcupines have long strong spines and a cleft upper lip. On their forefeet they have a wart-like protuberance instead of a thumb. The present family is found only in the Old World and is confined to the ground. They inhabit only Southern Europe, Asia and Africa. Some species are smaller and more slender than others and have a longer tail which is partially covered with scales.

The **African Brush-tailed Porcupine** is found in Africa, south of the Sahara.

In India, and up to South China, there is a larger species, the **Asiatic Brush-tailed Porcupine,** which has a short tail covered with hollow spines. The spines are most strongly developed on the rear part of the body.

The **Crested Porcupine** inhabits North Africa and more rarely Southern Europe, in Italy, Syria and Greece. Reports of its occurrence in Spain have not been confirmed. Many zoologists are of the opinion that the porcupine was brought to Europe by the Romans.

The crested porcupine is a robust animal with a short, blunt muzzle. It measures from $22^1/_2$ to $26^3/_4$ inches in length, with a tail measuring from 2 to $4^3/_4$ inches. The head and neck, the fore part of the body, and the belly are covered with bristles. The muzzle and the nose are covered with hair. The rest of the body is covered with hard, hollow black and white striped quills, which on the tail become open tubes. Formerly, porcupine quills were used for the production of pen-holders; the quills are from 12 to $15^3/_4$ inches long.

The porcupine lives in dry level country, or in foothills, where it can find plenty of food and where the undergrowth provides cover. It is a recluse and a grumbler. During the day it rests in natural hollows, or in ground cavities it has hollowed out for itself. In the evening, it leaves its den in search of food and spends the whole night foraging in the vicinity for roots, fruits, leaves and herbs. Like the majority of rodents it holds its food between its

Asiatic Brush-tailed Porcupine

Crested Porcupine

front paws when eating. It never ventures far from home. Its movements are slow and its intelligence is of a low order.

The sexes live apart except in the mating season. The gestation period is 60 to 70 days and the usual litter size from two to four young. The young are born with their eyes open. At birth the spines are short and soft, but they harden as they grow and soon reach adult size.

The defence posture of a threatened porcupine is of great interest. The animal turns side on to its enemy, shakes its spines and wags its tail, producing a rattling sound. At the same time it stamps with its feet. It squeaks and grumbles. In short, it tries to scare off the enemy by threat display.

The porcupine's quills are, of course, its main defence, but what are we to say of the idea that it can shoot its quills at an enemy? This has long been believed, and just as strenuously denied by zoologists. In 1954, a zoologist, named Klima, published the following in a scientific paper:

"In some records the authors definitely deny the correctness of the statement that porcupines can shoot their spines. I found, however, that this is wrong. When being transferred from its summer cage to its winter home in the Brno zoological gardens, an otherwise amiable porcupine became so excited that it shot, from a distance of two yards, several spines into the leg of one of the attendants. These spines were ejected from the porcupine with such force that they penetrated the keeper's skin and caused several stab wounds.

"One morning, in the middle of December, a porcupine was found dead in its cage in the Ostrava Zoological Garden. Investigation revealed several porcupine quills protruding from the region of its heart. These had penetrated into one of the ventricles and by severely damaging the myocardium had caused internal bleeding. In the cage were two male porcupines which must have been fighting and shooting spines at each other like arrows. On the floor of the cage many loose spines were found."

The fact that porcupines shoot their spines was mentioned by Pliny (c. A.D. 23—79), but few people believed this report. It was rejected as a fabrication, despite the fact that people living among porcupines continued to comment on this strange behaviour of angry, or scared animals. The English zoologist, Pocock, initiated a discussion on this question during which he received reports that there is indeed much truth in the old story. One report even mentioned that porcupine spines had been found six feet up from the ground in the bark of a tree. The porcupine had been caught in a trap set beneath the tree. The shooting of spines over short distances has been confirmed by employees of the Prague zoological garden.

Of course the facts have often been distorted, not least by Oppinianos who elaborated on Pliny by writing thus: "the porcupine is a most dangerous animal which, when fleeing, shoots spines at its pursuer so that hunters can catch it only by means of a ruse." However the fact has been confirmed that a porcupine can shoot its quills by sudden contractions of the subcutaneous muscles.

In the U.S.S.R., between the Caucasus and India, there is another species, the **Caucasian Porcupine,** which some Soviet authors identify with the **Indian Crested Porcupine.** The Caucasian porcupine measures up to $35\frac{1}{2}$ inches in length and is more boldly marked than the previous species. Concerning its breeding in captivity, Dr. Purkyně has written:

"They bear captivity very well. They are well hardened against winter and are easy to breed. They are not agile animals and appear to be quite indifferent to human beings. In captivity, they have only one wish — to gain freedom. In spring one of our porcupines mysteriously escaped, and we assumed that it got away from the zoological gardens, but in September one of the employees discovered a large lair in a deep, overgrown ravine behind the lion's cage. I thought at first it was the lair of a badger, so we began to dig for it. Very soon, we came across several porcupine spines. The lair then forked out in two directions and led very deep into the earth. After much strenuous digging, we discovered the escaped porcupine at a depth of ten feet. When we tried to catch it the animal shot out several spines which stuck into the walls of the corridor. Thus the fugitive had been living in the zoological garden for several months without anybody having seen it. As its new home was not far from an orchard, it must have been living mostly on fruit."

Dr. J. Komarek, writing of the function of porcupine quills, says: "Perhaps the porcupine knows what kind of weapons it carries and therefore it warns you. If you should happen to meet one on its ramblings it will not run away like other rodents. When faced by an enemy it first of all erects its spines which are otherwise kept folded down. The sharp points jut out in all directions, even those of the tail. This is the first attempt to scare the enemy, but the porcupine does not stop at bristling. It begins to rattle its spines threateningly and this is usually enough to scare any enemy off."

NEW WORLD PORCUPINES
Family ERETHIZONTIDAE

To this family belong porcupine-like rodents which live in trees. They inhabit North, Central and South America. Of the four known genera, we shall mention only the two most important ones. One is the genus of Brazilian Tree-Porcupine and the other the Canadian Porcupine.

The **Brazilian Tree-porcupine** has a clinging tail and four-toed feet. The spines are neither so strong nor so dense as in the Old World porcupines and grow sparsely out of the tough hair. These tree-porcupines are found in Central and

Canadian Porcupine

South America. During the day they sleep in the forks of branches. At night they move slowly in the crowns of the trees. They feed on tree buds, fruits, leaves and blossoms. Like all porcupines, they live singly outside the breeding season.

The best known of the South American porcupines is the Brazilian tree-porcupine, which is found in Venezuela, Guiana, Trinidad and some parts of Brazil. Unlike the other species, in which the bristly hair is longer than the spines, the Brazilian tree-porcupine has spines which are longer than its hair. This brings it more closely in line with the Old World porcupines.

The **Canadian Porcupine** measures up to $31\frac{1}{2}$ inches, its tail being about $7\frac{3}{4}$ inches in length. It is a robust animal with a short, blunt face. Its basic colouring is brownish-black. Some of the long spines and bristles are white. The tail is not prehensile.

This porcupine lives exclusively on the bark of trees which it peels with its teeth, thus causing considerable damage. Because of the damage it does to trees it is intensively hunted and its numbers are constantly decreasing. It begins to bark trees from the top, peeling first the branches and finally the trunk. Audubon reports having seen forests in which every tree had been stripped of bark. The Canadian porcupine spends most of its life high above the ground where it is completely at home. If disturbed on the ground it tries to escape into the nearest tree.

The Canadian porcupine does not hibernate, even in the coldest weather. It does, however, remain in the depth of the forest. During this period it grows a heavy coat which insulates it against the severest blizzards. This winter coat conceals all but the longest quills.

In defence, this species arches its body to the enemy. If attacked it delivers a swift blow with its short, spiky tail. If it makes contact some of the quills are driven home and become lodged. Quills which are more loosely attached shoot off and strike the enemy in the face. The most feared predators are the wolverine and the fisher; other carnivores will attack a porcupine only when the alternatives are porcupine or starvation.

CHINCHILLAS
Family CHINCHILLIDAE

This family of comparatively small rodents is found in South America. At first glance chinchillas resemble rabbits, except for their long, bushy tails and short ears. Most members of the family live in mountainous areas; only a single species lives on low ground. Chinchil-

las have the finest fur of all mammals and are almost uniformly coloured grey, or greyish-yellow.

The **Chinchilla** measures nearly one foot in length, plus a tail of about 5 inches. The fur is exceptionally thick and soft and of equal length over almost the whole body. The hairs are bluish-grey at the roots and tipped with dark grey. The overall colouring is silver grey and very beautiful.

The fur of the chinchilla has been in great demand since ancient times. During the Inca period, the Peruvians manufactured cloth from it. Since the end of the eighteenth century, large quantities of these furs have been imported into Europe and sold at high prices.

This highly profitable trade has, inevitably, led to a great decrease in the number of chinchillas, and to-day it is no longer possible to see them in the high cordilleras in the great numbers described by Brehm in his *Life of Animals*. The great colonies, numbering thousands, once found in Chile, Bolivia and Peru, have long ago disappeared and to-day the animal is found mainly in one small area of Bolivia.

Artificial breeding is difficult and, in any case, the fur of ranched chinchillas never approaches the quality of that of wild-bred animals living at an altitude of 6,000 to 9,000 feet above sea level.

There are two species of chinchilla, the Long-tailed and the Short-tailed. The short-tailed is slightly bigger in the body and has shorter hairs. Both have been kept in captivity and hybridised. The wild stocks are now strictly protected.

Belonging to the same family, and a close relation, is the **Long-eared Viscacha,** which is found at high altitudes in the mountains of South America. In general habits viscachas resemble the chinchillas. Their valuable fur, which is very expensive, is often used as a substitute for chinchilla, and such furs are called chinchillones.

The **Viscacha** resembles the true chinchilla more closely than it resembles the long-eared viscacha. It is, however, a robust animal with a large head and a short muzzle with long whiskers. Its upper fur is dark-grey, the under-fur white. Running across the cheek from the muzzle there is a light stripe. Unlike the other species, this viscacha lives on low ground and is found on the pampas from Buenos Aires to Patagonia. In some places it is still found in large numbers.

Viscachas are active at night and whole colonies of them can be seen by roadsides in the late evening. They are highly gregarious and colonies are usually large. In cultivated areas they are never welcome because they graze all the vegetation in the vicinity of the colony. Many colonies are decimated by constant killing.

The females have two families a year,

Chinchilla

Viscacha

numbering from two to three young. Viscachas have long been noted for their habit of carrying objects home and the habit was mentioned by Darwin who wrote: "Around every viscacha colony we find many animal horns, bones, rocks, clods, et cetera, and each of these heaps would fill a wheelbarrow."

It is very probable that such hard objects are used by the viscachas for polishing their incisor teeth.

The burrows of the viscachas are a hazard to horses which sometimes break a leg by stepping into them. Deserted burrows are sometimes used by birds, for example, certain owls.

The fur of the viscacha is not as valuable as that of the chinchillas or the long-eared viscacha but it has some value and is used in the fur trade. Viscachas are easily kept in captivity and are frequently seen in zoological gardens.

AGOUTIS AND PACAS
Family DASYPROCTIDAE

Agoutis are colonial animals, found on high plateaux and mountain slopes. They are mainly nocturnal animals and are seldom seen during the day. They are prolific breeders but have a great number of enemies, the most dangerous being man, who hunts them for their fur and their meat. All the agoutis are herbivores, living on roots, leaves, bark, fruit, et cetera. They live in natural shelters between rocks and under boulders, but sometimes dig their own burrows.

The **Golden Agouti** is often kept in zoological gardens where it breeds freely. A mature male will measure up to $15\frac{3}{4}$ inches in length with a short tail of about half an inch. This species is very handsomely marked, each hair being striped black, brown and gold. Some hairs terminate in a light, and others in a dark stripe; thus it happens that the animal changes colour as it moves according to the direction of the light.

Golden Agouti

The golden agouti lives in the basin of the Amazon and in Eastern Peru, where it inhabits forests and open areas near forests; it avoids treeless regions. It is a very timid animal and spends the daylight in concealment, venturing out only in the evening in search of food. It is mainly a vegetarian but sometimes it will hunt small birds and large insects. In this respect it resembles most of the rodents,

among which there are only a few that are exclusively vegetarian.

The **Spotted Paca** has a remarkably large head, large eyes and small ears. It has short legs. Its bristly hair is reddish-brown on the back and sides, and yellowish-brown on the under parts. On both sides, there are five rows of white spots.

The spotted paca is found over large areas of South America, mainly along rivers. It avoids human settlements but frequently causes damage to cultivated plants, particularly maize. On the forest edge and preferably in damp places, it excavates burrows up to six or seven feet deep. In these, it sleeps throughout the day. The meat of the spotted paca is reputed to be good and the animal is much hunted. A mature male will measure up to 27½ inches in length and weigh about 20 pounds.

THE CAPYBARA

Family HYDROCHOERIDAE

The **Capybara** is the largest member of the whole order of rodents. It is about 36 inches in length, stands 18 inches tall and weighs about 110 pounds. Its body is robust and clumsy, the neck short, the head large and unattractive and ending in a blunt muzzle. The cleft upper lip reveals broad, grooved incisors. The hind feet have three toes and the front feet four.

The female capybara cannot be distinguished from the male merely by looking at her as there is no difference between the sexes in shape or markings, and even the sexual organs and anus are hidden in a special skin fold. A gland in the upper part of the muzzle produces a musky secretion during the mating period. This secretion is probably used in the marking of territory or for keeping individuals of opposite sex in touch with each other. The usual colour of the capybara is brown.

The capybara inhabits a vast area of South America between the rivers Orinoco and La Plata, and between the Atlantic coast and the foothills of the Cordilleras. In some parts it is extremely common, particularly in moist, swampy localities near rivers. It likes to hide in thick undergrowth and spends the hot day in the shade.

Modern zoologists have confirmed the fact that the capybara will sometimes range up to distances of half a mile from the nearest river. Nevertheless, it is still true to say that it lives near water or in swamps. It has short swimming webs between its toes and is perfectly at home in the water. It swims well and fast and can stay submerged for long periods. On land it is clumsy, and if surprised there it will run diagonally towards the water, emitting a warning signal that can be heard

Capybara

over long distances. Under natural conditions the capybara often lives in large colonies, but in captivity it is intolerant of its own kind.

When a capybara is eating aquatic plants, the grinding of its powerful molars can be heard at a considerable distance, but Krumbiegel says that this clapping is also a sign of excitement and can be heard when the animal is not eating.

The fur of the capybara is of no commercial value, but this does not mean that it is safe from hunters, who shoot it for sport, or for its flesh which has a muddy taste. Its main natural enemies are the puma, the jaguar and the alligator, but the most dangerous and destructive of all is man.

Capybaras reach sexual maturity at three years of age. The gestation period is from 104 to 111 days and the usual number of young in a litter is two. If taken young, the capybara tames easily and becomes very friendly.

GUINEA PIGS
Family CAVIIDAE

Guinea pigs are close relatives of the capybaras, and the **Restless Cavy** is known all over the world. It is a cobby, friendly, attractive animal, often kept as a pet in houses, sheds or rabbit hutches. Nowadays, the guinea pig plays an important part as a laboratory animal. Every large research institute, hospital and biological research station keeps guinea pigs, which are used for the most diverse scientific experiments.

Domestic Guinea Pig

In captivity the guinea pig's requirements are modest. It is content with small living space and will thrive on grass, leaves or root vegetables, and corn. Its vocal displays are confined to squeaks and grumbles.

Unlike so many rodents, the guinea pig is not a prolific breeder. The gestation period is surprisingly long for an animal of the size (63 to 66 days), and the number of young in a litter is usually fewer than five, and two or three on average. The young animals are not mature until the age of eight or nine months.

By means of artificial breeding man has evolved several interesting types, for example, the **Angora Guinea Pig,** which has long, soft hair, and the **Brazil Guinea Pig** whose hair is partially curled. The common domestic guinea pig is now bred in a wide variety of colours and markings. Besides white guinea pigs there are mottled ones and tricolours, and combinations of black, white and red.

The guinea pig was introduced to Eu-

rope from Peru soon after the discovery of America. In its native land it had long been kept as a domestic animal by the Incas; this has been established by the finding of mummified guinea pigs in old burying places among the mummies of dogs and llamas. It is very likely that the ancestor of the domestic guinea pig of the old Peruvians was **Cutler's Cavy.**

In Great Britain, the guinea pig has never been considered as a food animal, but in some parts of Europe, especially in the south, restaurants serve roast guinea pig as a common dish and animals already skinned for cooking are sold in the markets.

In his artificial breeding experiments, Nehring proved that the wild guinea pig crossbreeds with the domestic variety, although previously this had been denied.

Wild guinea pigs are found at lower altitudes in South America between Guiana and the Argentine.

The lowland species is the pig-like cavy. Both species of wild guinea pigs, the mountain and the lowland, are probably only geographical races of the same species.

In America, the guinea pig inhabits open, grass- or bush-covered areas in large numbers. Hech says about it that:

"Nobody shoots or hunts it; nobody pays attention to it. Everybody sees in it an unimportant animal."

The first wild guinea pigs did not find their way into European zoological gardens until the end of the nineteenth century.

The **Patagonian Mara** is a rodent of the guinea pig type. This species inhabits the steppes and deserts of Patagonia. A mature mara will measure $19^1/_2$ inches in length, plus a short tail of $1^1/_2$ to 2 inches. Its hair is soft and short, brownish-grey above and whitish below. Maras are very popular in zoological gardens, where people often stop in front of their enclosure and exclaim: "What strange hares". The mara actually resembles a hare, but has longer legs and shorter ears. Its claws are really small hoofs. Unlike the majority of rodents it is active by day and likes to bask in the sun. It does not thrive in a moist climate.

Maras have been introduced to several parts of Southern Europe and the U.S.S.R.

Brazil Guinea Pig

Patagonian Mara

The mara is a vegetarian. Colonies of a few score animals are the general rule but the species is far less numerous than it used to be. The usual pace is a short hop but when threatened with danger, the mara can run very fast and make leaps of six feet or more. Two litters are reared in a season, the young numbering two or three and being born in an underground nest.

ORDER: CARNIVORA

Carnivores, as the name indicates, are flesh eaters and are perfectly adapted for catching and killing live prey. In nature they play an important part in controlling the large numbers of herbivorous animals, thereby helping to keep species in proper balance. To-day we understand quite clearly that carnivores help in maintaining the equilibrium of nature.

Many people, however, still hold a different opinion of carnivores, seeing them merely as harmful animals to be killed on sight. This is a one-sided view. It is not always possible to lay down hard and fast rules about useful and harmful animals (i. e. useful or harmful to man), and this can be best illustrated by a few examples.

The weasel is a highly specialised killer of small mammals, and is supremely adapted to catch harmful species like voles and mice. It has a slender body which enables it to enter even the smallest hole. Every year a single weasel will kill many hundreds of voles and mice which would otherwise consume vast quantities of grass and corn. Thus, so far as agriculture is concerned, it is one of the most useful mammals. But it is useful to man in other ways, and not least to his farm animals, because it kills rats and mice which are often responsible for transmitting dangerous diseases. Gamekeepers, on the other hand, see the weasel only as a predator on hares, patridges and pheasants, and shoot them whenever they come across them — which is a great mistake.

Now let us look at the Wild Boar. Many farmers would like to exterminate it completely because it often lays waste crops in the fields. Yet, in forests, the wild pig is a most useful animal because it eats the larvae and chrysalides of harmful insects and even catches mice and voles.

The fact is that no animal is a pest all the time, and few of them are pests even most of the time. What has to be emphasised is — that it is quite wrong to wage war against any animal before its status has been properly studied. We have to examine its uses as well as its predation. No animal is either entirely useful or entirely harmful. The roebuck, for example, is a very important game animal, yet it can do quite considerable damage to seedling trees by nibbling at the shoots. Yet the pheasant, which picks grain from sown fields, is not considered a pest because of its sporting value. The carnivores have always been suspect because their killing is obvious, whereas their value is much less so.

It has always been said that the carnivores are perfectly designed to capture live prey, and this is shown most strikingly by their teeth. All carnivores have long, sharp canines with which they kill their prey. In the upper jaw the last grinder, and in the lower jaw the first molar, are modified into the so-called carnassial teeth which have a sharp knife-like crown. They help to tear up the prey, hence their name. Certain carnivores are omnivorous (bear and badger for example), and in these the carnassial teeth are less well developed.

The lower jaw of the carnivores is very firmly attached to the skull and can move only up and down. (In ungulates this is not the case; they can move the lower jaw sideways.) The teeth of carnivores are also excellent defensive weapons.

With very few exceptions carnivores have highly developed senses, especially their

sense of smell. Related to this there is the development of a variety of scent glands whose pungent secretions are often powerful enough to be smelt by man. These glands are usually situated under the tail; their importance varies from species to species, and they serve several purposes. They help individual members of the species to find each other, and they are also used for marking out territory. In some carnivores these anal glands have developed into a defensive device, as in the case of the North American skunk.

Their sense of hearing is also well developed, their eyesight less so — except in the case of the cats, which have good vision.

A notable feature of the carnivores is their playfulness, as anyone can observe by watching a litter of kittens or pups. The same playfulness can be observed in wild carnivores. Adults play with their young and sometimes with their victims. The young play with each other. Some carnivores have well developed vocal powers, and all of them are capable of some kind of vocal display. An obvious example is the dog, which can display pleasure, fury or fear by means of its voice.

Carnivores are divided into several families.

CATS, Large and Small
Family FELIDAE

Cats are certainly among the most perfectly developed carnivores and are readily distinguished from other types by their rounded heads and short muzzles. Unlike other carnivores most cats have only thirty teeth, including their canines and carnassials.

With the exception of the cheetah all the cats have strong, sharp, retractile claws. This ingenious device protects the claws from wear when the animal is walking. Like the human finger-nail the claws are fixed on the end of the last joint of the toe, where there is a bone sheath into which it can be retracted. When the claw is retracted the end joint is folded back by means of a special ligament resembling a steel spring. A special arrangement of tendons and ligaments unsheaths the claws when the toes are stretched.

Because they can retract their claws cats tread only on the elastic pads of their feet and so are able to move about silently. Their gait is usually light and elastic. No other carnivores, and certainly no other mammal, can move with such grace and precision.

Cats usually seize their prey by means of a sudden attack from close quarters, after an initial stalk. They have great muscular strength and can hold down their prey with ease. They have an excellent sense of balance and can jump from great heights without suffering injury. Even if they fall backwards they can right themselves in the air and always land on their feet. Thus they move about confidently in trees, where they often lie in wait for their prey.

Hearing is probably their most perfectly developed sense, and its range includes sounds too high pitched for the human ear.

Unlike most carnivores the cats have good eyesight and the lynx has better eyesight than a man. Like man and monkeys, cats have colour vision, so they see the world around them in colour. The other carnivores do not have colour vision. They see everything in black and white, with shadows of grey as in a monochrome photograph.

The eyes of cats and other carnivores shine at night. This is because rays entering the eye are absorbed by a layer of sensitive cells — the retina. Whatever the cat sees is projected on to the retina by means of a lens, as in a camera. The absorbed light is then reflected back to the retina, thus making maximum use of the available light. We might compare this layer of cells to the reflector on a bicycle, which reflects back the light from the headlamps of a following car. The same happens if we shine a light into the eyes of a cat — the reflecting layer behind the retina immediately begins to shine. This arrangement is important at night when there are very few light rays; the reflecting layer amplifies their effect.

At night the irises of the cat's eye are wide open, like the diaphragm of a camera lens, but during the day they shut down to protect the eyes from excessive light. The widening of the irises at night enables the cat to make maximum use of available light in the same way as a photographer opens up the lens of his camera in bad light. During the day, when the pupils contract into narrow perpendicular slits, the cat is not dazzled even in bright sunlight.

By comparison, the cat's sense of smell is poor; but it is far better than a man's, although not nearly so good as a dog's. Many cats, including lynxes, are therefore easily caught because they cannot smell a well hidden steel trap.

The cat family is divided into several groups, separated according to their size and by certain characteristics of their skull. The group known familiarly as the Big Cats includes the lion, the tiger and the leopard. The big cats cannot purr like the small ones; they roar.

Perhaps the most widely known of the big cats is the **Lion.** The lion was familiar to the ancient Egyptians, Greeks and Romans and many of their stories and fables concerning it have survived to the present day.

The so-called king of beasts does not live in the desert as frequently stated. Like all carnivores it requires water, without which it would perish, so it is found on steppes and savannas, densely covered with bushes; there its sandy colouring blends perfectly with the parched ground and sunbleached grass.

In old books on natural history we often read about the chivalrous behaviour of the hunting lion. It is said to give a loud roar to warn other animals that it is ready to set out in search of prey. Actually it behaves like any other predator. Sometimes a single lion will lie in wait by a watering place. But it is the only truly social species among the cats and often hunts in family parties. Two or three lions will circle silently round a grazing herd of zebra or antelope while the other lions of the group drive the herd into the ambush. They start the herd moving by means of their roaring. There is nothing chivalrous about this style of hunting.

The lion's roar serves another purpose. It is a warning signal to trespassing lions to stay out of the roarer's hunting territory. Similar vocal signals are used by other animals — for example, the roaring of stags and the singing of birds.

When the lion is within striking distance of his prey he leaps on to its back and takes hold firmly with his claws. Then, gripping with his teeth, he twists the head of his quarry and breaks its neck. At least that is what happens when the lion is successful — but he is not always successful in his hunting and oc-

casionally he becomes the victim. Africans tell of finding dead lions which have been stabbed by the pointed horns of antelopes. In another case a giraffe had shattered a lion's skull with a violent kick. Others die from the penetration of a porcupine's quill.

The elephant, buffalo and rhinoceros are the only animals which the lion fears, and he avoids them. He knows that his strength is no match for theirs and that they would almost certainly kill him in a fight. But he sometimes kills their young when one wanders away from the care of its mother.

Zebras and antelopes are the lion's main prey and his predation is an important factor in controlling the number of these animals. In areas where man has exterminated the lion, ungulates like zebras and antelopes multiplied to such an extent that they devasted their range, then died off in great numbers as the result of starvation or epidemic disease. Such diseases are sometimes transmitted to domestic cattle. Nowadays, the real value of the lion as a predator is better understood and in most modern African states the killing of lions is strictly controlled. In some it is strictly prohibited.

However the lion kills prey other than zebras and antelopes, and stomach analyses have revealed such items as birds, mice, insects, lizards and even locusts. This shows that the lion is quite adaptable in the matter of food, and it will even eat carrion. Lions in captivity require about 18 pounds of meat a day. Wild lions may require more than this and in fact they usually gorge themselves then rest for several days. It has been said that a pride of lions will kill only once a week. "Pride" is the name given to a group of lions.

It is an interesting fact that zebras and antelopes know when their enemy is satiated and therefore no longer a threat to them. Concerning this B. Machulka, a traveller, says:

"Once, before sunrise, I was lying between boulders on the top of one of the hills watching the animals. The young luxuriant grass had attracted great herds and hundreds of Thompson gazelles were grazing. From where I lay one side of the plain looked as though it was dotted with cork chippings. Directly opposite me there were herds of roan antelopes and zebra. Its was quiet everywhere and all the animals were grazing. Then, suddenly, I saw that the herds were opening up at one side, leaving a wide, open passage; shortly afterwards I saw a group of lions slouching along with the relaxed gait of well-fed animals. They paid not the slightest attention to the herds, but now and again one of them would wave its tail, as cats do.

"The zebras and antelopes stood with their heads turned towards the open passage and watched the lions. On two occasions a young animal ran out of the lines and made several jumps towards the lions, then it turned about and returned to the herd. The scene was like a parade of royalty between rows of admiring subjects. The animals in the herds were obviously quite aware of the fact that the lions were not hungry and therefore not to be feared. The lions walked on slowly and finally disappeared along the shore."

As already mentioned, lions frequently hunt in packs. The pack may consist of an old couple and grown-up young, or of one or more adult lions and a number of adult lionesses and younger animals.

Stories about the strength of the lion

are usually exaggerated. For example, it is not true that a lion can jump a ten feet fence carrying a well-grown calf in its jaws.

Lions often bury their prey to protect it from hyenas, vultures and jackals, and have often been observed watching over a kill. They lie down within easy reach of the carcass, and the members of the pride take turn about at guarding it. When devouring its prey the lion first of all eats the entrails, which appear to be a great delicacy; then it turns to the flesh. The remains of a feast are never wasted. No sooner have the lions finished than hyenas, vultures, jackals and marabou storks assemble at the carcass; and within a short time only the large bones are left.

Lions that have lost their fear of man sometimes take to killing his domestic livestock, which fall an easy prey. A few may even become man-eaters. Usually, however, lions go out of their way to avoid man, but if they become familiar with him they can be bold and aggressive.

Many true and interesting stories have been told and recorded about the relationships between lions and men during the construction of the Uganda railway. A number of enterprising lions gave up hunting wild game and became specialists at stalking the workers employed on the railway. With great boldness they entered the huts at night and pulled the sleeping workers from their beds.

Two telegrams have been preserved which refer to the lions just mentioned. Some lions had laid siege to a small isolated station and the railway workers had to call for help. Railway headquarters at Nairobi received the following telegram: *TIME TEN MINUTES TO TWO: LIONS ARE ON VERANDA. PLEASE INFORM ENGINE DRIVER AND GUARD TO ENTER STATION QUIETLY AND CAREFULLY: WARN PASSENGERS NOT TO LEAVE TRAIN: LOOK OUT ON WAY TO OFFICE.*

The second telegram reads: *SIGNALMAN ATTACKED AND SURROUNDED BY LIONS WHEN RETURNING FROM SIGNAL BOX — NOW SITTING ON TELEGRAPH POLE NEAR WATER TANK. PLEASE STOP TRAIN HERE: TAKE HIM WITH YOU AND CONTINUE WITH JOURNEY.*

Lioness with cubs

These exciting days are now past. Lions have since been exterminated in many places and to-day they are found in the greatest numbers in national parks where they have learned to accept man as part of the landscape. Motorists now stop to take pictures of them and no case of a lion killing a man has been reported.

Machulka the traveller has described how he once "angled" for a lion.

"A dead zebra was tied to the car by means of a rope and dragged behind when the car was in motion. No sooner had the lions seen the approaching car than they ran towards it, leapt on to the dead zebra and allowed themselves to be pulled for some distance while they were eating. They paid no attention to the humans and did not seem to mind being photographed. Only when the photographer approached too closely with his camera did they bare their sharp canine teeth threateningly and growl at him."

There are no heroics in present-day lion hunting. The modern rifle has made it possible for the hunter to kill his lion at long range so that he is never in the slightest danger. The Negroes, however, hunt the lions with spears. A group of them surround the selected lion and provoke it until it attacks. As soon as the animal attacks, the Negroes protect themselves with their shields and stab at it with their spears. Usually the lion is quickly speared to death.

In his book of travels, Machulka describes the hunting of lions with rifles.

"It is almost impossible to hunt down a lion by stalking, or according to any fixed plan. Success is usually a matter of chance. We had arranged to explore the banks of the Nile as we expected to come across lions there. It was still dark when we set out on our trip and we saw several species of animals in the dark, but no lions, although we had heard their roars earlier. Meanwhile the sun was rising and with it the temperature. According to my estimate we should long before have reached the place where we had heard the lions roaring, but there was no trace of them. Anyway we kept on walking, then, suddenly, one of the shikaris shielded his eyes with his hand, stared at something in the distance, snapped his fingers and turning to me said, 'Sir, look at those termite hills with your field-glasses. There is something like a lion's head there.' I looked and presently was able to see the head of a lion. That shikari must have had the eyesight of an eagle for only the head and part of the mane were showing. We left one of the shikaris behind with the donkeys to hold the lion's attention and began to stalk towards the termite hills.

"We were perspiring profusely before we succeeded in approaching the lion from behind. At the first shot the lion rolled down the hill. However, we approached cautiously in case the animal was only wounded. It certainly was not dead because when we reached the spot where it had rolled over it was no longer there. Now we took added precautions because we obviously had a wounded animal to deal with. Two shikaris took up positions behind us carrying spare rifles and long spears and we started searching for the lion.

"There were no traces of blood to be found anywhere and we were kept in suspense for a long time, or so it seemed, before we heard a growl. Then the lion appeared suddenly at a distance of about twenty paces. He was roaring furiously and displaying his shining teeth. It was an impressive and savage sight and the

VI 1. *Lion* 2. *Cheetah* 3. *Leopard* 4. *Snow Leopard* 5. *Jaguar* 6. *Bengal Tiger*

lashing of the tail was a clear indication that the lion was prepared to fight for his life. He was badly placed for a safe shot. We took aim as he lowered his head and waited for him to charge, which he soon did. He came on at great speed, a magnificent and terrible sight, full of strength and courage. When he was halfway towards us we fired and he dropped, but he had to be shot once more before he died. All his power and savagery had been of no avail against a modern large calibre bullet. We discovered afterwards that the first bullet had merely grazed his skull and stunned him."

In the breeding season lions often fight over the lionesses, dealing each other heavy blows with their forepaws, but they are protected by their manes and rarely wound each other seriously. The lioness has two to three cubs at birth after a gestation period of 102 to 105 days. At birth the cubs are about one foot long. They are blind for about two weeks and the lioness take great care of them. During the first month of their life she does not leave them for a moment, and spends all her time licking and mothering them. The lion is a good father and supplies her with meat so that she does not have to leave her cubs, which, at this stage, would be an easy prey to such dangerous hunters as the hyenas. Hyenas regularly search for abandoned lion cubs and apparently consider them a delicacy.

Like all kittens, lion cubs are extremely playful.

The fur of the young lions is darkly spotted, and some of them remain spotted right through to maturity, that is until they are four years old. The usual life span is twenty years. Some lions live to the age of thirty.

To-day the lion is found in Africa, south of the Sahara, and in India; but the Indian species has been almost exterminated. In the Kathiawar Reservation north-west of Bombay there are now no more than 290 of them left.

The original range of the lion was much more extensive. At one time it was found in Southern Europe, but was exterminated there. It suffered the same fate in Asia Minor and in North Africa.

There are several races of lion, differing from each other in size and in the shape of their manes. It must, however, be pointed out that the lion's mane is never so luxuriant in wild animals as it is in lions kept in captivity. The mane of the wild lion is thinned out considerably by fighting and by contact with bushes and other vegetation.

The largest of the lion races was the **Cape Lion** which used to live in South Africa, but it was long ago exterminated there. The last animals of this race were shot in Cape Colony in 1858, and in Natal in 1865. The same fate was met by the **Barbary Lion** which used to live in North Africa. It had a mane on its head, neck and belly.

The smallest race is the **Somali Lion.** The **East African Lion** inhabits the plains of East Africa and has long legs and a short mane.

Man has kept lions in captivity since ancient times, probably because this great cat settles down qtuickly in captivity and thrives. It can also be taught to perform various tricks. Lions can be seen in every zoological garden. They breed in captivity and adapt themselves to almost any climate. Some zoological gardens have bred hundreds of lions, and first place in this respect must go to the zoological garden in Leipzig where a thousand were

bred before World War II. Leipzig Zoo has exported lions all over the world, including to South Africa.

To-day wild lions are no longer hunted for export to zoos. It is much easier and cheaper to breed them in captivity. People who shoot wild lions to-day do so entirely for the so-called sport. Fortunately, a number of extensive game reservations have been established in Africa and there the lions are left in peace, so that for the time being at any rate the species is safe.

A close relative of the lion is the **Tiger,** which is the largest living cat. The biggest race of tigers is found in Siberia where the animals weigh up to 6 hundredweights and measure 13 feet from nose to tip of tail. The tiger can be distinguished at once from the lion by its striped fur. Yet, although the two are so strikingly different in external appearance, their skeletons are almost identical and only an expert could tell which skeleton belonged to which animal. Their close relationship is revealed under their skins.

Apart from differences in shape and colouring, the tiger differs from the lion in habits and habitat. If we look closely at a tiger in a zoological garden we shall see how slender it is, despite its great size and powerful build. Its body, which has flattened sides, is adapted to a life in forests and jungles. Jungle animals, in the truest sense of the word, must be able to squeeze between bushes and trees. So, in the case of carnivores which have to stalk their prey, this body shape is of the utmost importance.

Unlike the lion, the tiger inhabits forests and jungles. There, its colour is important. The light and dark stripes of its coat are perfectly suited to such an environment and zoologists say that when a tiger runs through a forest it looks grey even when seen at short range. This means that its colouring, which seems so conspicuous to us, is quite inconspicuous in the tiger's natural surroundings.

Again unlike the lion, the tiger is not confined to tropical or even warm regions. It ranges over the whole of India and is found in Korea, Manchuria, Mongolia, China and Siberia. In Transcaucasia it has spread to the eastern Caucasus. In Central Asia and India it moves high into the mountains in summer, and has been recorded regularly at altitudes of over 9,000 feet. The tigers of Central Asia, Manchuria and China can thrive in temperatures of —30° Centigrade in winter.

Siberian Tiger

The largest race is the **Siberian,** or **Amur Tiger,** which differs from all the others in having a very long, thick, winter coat. Its tail is also thicker furred and much more shaggy than in all the others. The Siberian tiger is not so brightly coloured as the tropical races, being dull yellowish orange in winter and only slightly redder in summer.

In the whole of the Far East, that is in Manchuria and South-east Siberia, there were about one hundred of these tigers at the beginning of the 1960s. In these areas the animals are protected by law.

The second largest race is only slightly smaller than the Siberian. This is the **Bengal Tiger** which has shorter hair and a tapering tail and is much more brightly coloured. The Bengal tiger inhabits India from the Himalayas to Cape Comorin in Southern India. Other continental races are the **South Chinese Tiger** and the **Caspian Tiger.** The Caspian race has longer and thicker hair and the stripes of its flanks are brownish black instead of black.

The smallest of the so-called island races is the **Sumatran Tiger** which is found on the island of Sumatra. It is much smaller than any of the races already mentioned and is beautifully coloured, its fur being deep orange with broad black stripes.

The tiger is the biggest and strongest of the big cats and probably the most perfectly adapted to its way of life. It has no natural enemies except perhaps a small dog-like Indian carnivore which stands about $19^1/_2$ inches tall and measures about 3 feet in length. This animal hunts in packs which have been reported chasing a tiger to death. It seems, however, that this applies only to young, inexperienced tigers or to the very aged. The pack is reputedly capable of overcoming a tiger by tearing out pieces of flesh until the hunted animal succumbs from loss of blood. The scant evidence available, however, suggests that this happens only in most exceptional circumstances.

Tiger

Tigers, like lions, seldom dare to attack an elephant. The elephant's tremendous size and strength are enough to daunt even this powerful carnivore. For this reason elephants are used on tiger hunts. The hunters sit aloft in comfort and safety while natives beat through the jungle and drive the tigers towards the mounted hunters. During such drives native beaters are sometimes killed.

As a general rule the tiger avoids man, but it will attack if wounded or over excited and charge blindly into a group of hunters. Native spears are of little use against a charging tiger and even the modern rifle can be a poor insurance. The tiger attacks with such speed that the hunter seldom has time to take proper aim. When a tiger weighing up to six hundredweights leaps on to its victim's back, raking with its claws and teeth, there can be but one result — the tiger breaks the victim's neck.

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Unlike the lion, the tiger inhabits forests and jungles. There, its colour is important. The light and dark stripes of its coat are perfectly suited to such an environment and zoologists say that when a tiger runs through a forest it looks grey even when seen at short range. This means that its colouring, which seems so conspicuous to us, is quite inconspicuous in the tiger's natural surroundings.

Again unlike the lion, the tiger is not confined to tropical or even warm regions. It ranges over the whole of India and is found in Korea, Manchuria, Mongolia, China and Siberia. In Transcaucasia it has spread to the eastern Caucasus. In Central Asia and India it moves high into the mountains in summer, and has been recorded regularly at altitudes of over 9,000 feet. The tigers of Central Asia, Manchuria and China can thrive in temperatures of —30° Centigrade in winter.

The largest race is the **Siberian,** or **Amur Tiger,** which differs from all the others in having a very long, thick, winter coat. Its tail is also thicker furred and much more shaggy than in all the others. The Siberian tiger is not so brightly coloured as the tropical races, being dull yellowish orange in winter and only slightly redder in summer.

In the whole of the Far East, that is in Manchuria and South-east Siberia, there were about one hundred of these tigers at the beginning of the 1960s. In these areas the animals are protected by law.

The second largest race is only slightly smaller than the Siberian. This is the **Bengal Tiger** which has shorter hair and a tapering tail and is much more brightly coloured. The Bengal tiger inhabits India from the Himalayas to Cape Comorin in Southern India. Other continental races are the **South Chinese Tiger** and the **Caspian Tiger.** The Caspian race has longer and thicker hair and the stripes of its flanks are brownish black instead of black.

The smallest of the so-called island races is the **Sumatran Tiger** which is found on the island of Sumatra. It is much smaller than any of the races already mentioned and is beautifully coloured, its fur being deep orange with broad black stripes.

The tiger is the biggest and strongest of the big cats and probably the most perfectly adapted to its way of life. It has no natural enemies except perhaps a small dog-like Indian carnivore which stands about $19\frac{1}{2}$ inches tall and measures about 3 feet in length. This animal hunts in packs which have been reported chasing a tiger to death. It seems, however, that this applies only to young, inexperienced tigers or to the very aged. The pack is reputedly capable of overcoming a tiger by tearing out pieces of flesh until the hunted animal succumbs from loss of blood. The scant evidence available, however, suggests that this happens only in most exceptional circumstances.

Tiger

Tigers, like lions, seldom dare to attack an elephant. The elephant's tremendous size and strength are enough to daunt even this powerful carnivore. For this reason elephants are used on tiger hunts. The hunters sit aloft in comfort and safety while natives beat through the jungle and drive the tigers towards the mounted hunters. During such drives native beaters are sometimes killed.

As a general rule the tiger avoids man, but it will attack if wounded or over excited and charge blindly into a group of hunters. Native spears are of little use against a charging tiger and even the modern rifle can be a poor insurance. The tiger attacks with such speed that the hunter seldom has time to take proper aim. When a tiger weighing up to six hundredweights leaps on to its victim's back, raking with its claws and teeth, there can be but one result — the tiger breaks the victim's neck.

From time to time the big cats (lion, tiger and leopard), take to hunting the easiest of all prey — man himself. But it must be understood that man-eaters are the exception. Most tigers do not attack man.

The late Jim Corbett, one of the great experts on tigers who specialised in shooting man-eaters, has always pointed out that the man-eater is almost invariably an animal suffering from some kind of injury (a bullet wound or porcupine quills), and therefore unable to hunt its usual prey. Nevertheless, the damage done by a man-eater can be catastrophic. In 1960, for example, tigers in the Madhjapradesh district of India killed fifty-two people within three months. Jim Corbett shot a man-eating tigress in the sub-Himalayan Kumaon which had killed 434 people. This was the famous Champawat man-eater. Such animals are a scourge in the whole region they inhabit and they are so fearless of man that they will even approach human dwellings in broad daylight. In very rare cases a human being may succeed in escaping from the clutches of a man-eater. Jim Corbett recorded one such case in 1944.

"A really peculiar case in which a man attacked by a tiger succeeded in saving his life at the last moment occurred in the sub Himalayan Kumaon. A native was cutting grass above a steep slope, and just when he was tying up the grass he was attacked by the tiger which was known throughout the region as the Chowgarh man-eater. The tiger got hold of the man's head with its jaws. One of its fangs penetrated his cheek under the eye, one canine penetrated his chin, and the remaining two penetrated his neck where it joins the back. With its great weight the tiger bore the man to the ground. Fortunately, he did not lose consciousness. Chest to chest, man and tiger lay on the edge of the steep slope. However, when falling to the ground, the man had managed to get hold of a small tree, and his arms and legs were still free. As all cats do, the tiger held its victim for a while after the attack. In spite of the terrible pain, the Indian slowly drew up his legs and pushed violently against the tiger's belly. In this way he succeeded in pushing the tiger over the edge of the slope and so saved his life. The tiger fell down the slope and did not come back. The severely wounded man bandaged his head with his loin cloth and succeeded in reaching his village. His wounds healed and his strength slowly returned. When he was well again only his terribly disfigured head bore witness to the fact that he had come so close to death."

It is an interesting fact that in Manchuria and Siberia man-eating tigers are practically unknown and within the last hundred years there has not been a single record of a tiger killing a man.

To-day the tiger is protected throughout its range. Farmers have now realised the importance of its predation on other species — for example how it helps to control grazing animals. In areas where tigers had been exterminated the wild boar multiplied unhindered and caused tremendous damage in young plantations by rooting in the ground. Tigers indeed are specialist predators on wild pigs, but of course they kill a variety of hoofed animals, including buffaloes and deer of many kinds.

Near the River Amur in the U.S.S.R., hunters once found the remains of a bear in the stomach of a tiger. So, despite its tremendous strength, the bear sometimes falls victim to the big cat. Such an en-

counter must result in a terrible fight and it is very likely that the tiger attacks the bear only in a case of extreme emergency.

The tiger usually pulls its prey into some dense thicket before beginning its meal. Like all the cats it spends rather a long time over one meal. Quite frequently it plays with the dead prey or spends a long time licking it with its tongue, which is as rough as a grater. A strong and healthy tiger will consume up to 66 pounds of meat at one meal. The gorged animal lies down in some sheltered spot close to water and spends the next three days or so digesting its meal. In zoological gardens, where it is regularly fed, the tiger will eat 17 pounds of meat a day.

Stomach analyses of wild tigers reveal that they eat a variety of small mammals as well — birds, frogs, mice and insects. They also eat a certain amount of fruit.

Tigers are not notably nocturnal. In fact when not greatly disturbed they are active mainly by day. A single animal holds a large territory and will cover over six miles a day. It moves far more stealthily than the lion and is far less vocal. It has a deep grumbling growl, like ah-oh-oong, which is heard only during the mating season. Another sound uttered by tigers resembles a mewing "wou".

There is another striking difference between lions and tigers. The tiger loves water, bathes regularly, and is an excellent swimmer. This explains how one often appears on an island separated from the mainland by a wide stretch of water. Many observers have recorded a tiger swimming across a strait two or three miles in width.

On the other hand, tigers never climb trees; so natives often save themselves by climbing into one. The tiger looks up a tree only when it wishes to scratch the trunk with its claws. It sinks them deep into the bark and grinds them by pulling them downwards. In this way the tiger marks out its territory.

The tiger is a first rate jumper and an expert stalker, and despite its great size it can crawl unnoticed even in short cover. Typically, it stalks to within 20 yards of its quarry, then closes with it in swift bounds.

In spring the tigress prepares a warm lair for her young, lining it with hair. Her den may be situated in a rock cavity or under a fallen tree. The gestation period is 105 to 109 days. The cubs, which number from two to four, sometimes up to six, are blind until the twentieth day. From the beginning they have the typical striped coat. Young tigers which are bred in captivity are quiet from the beginning, and remain docile even when adult. Of course not even the tamest tigers can be fully trusted in all circumstances. One of their favourite pastimes is jumping on their keepers, but a big tiger can injure a man severely, even if accidentally, with its powerful claws.

In zoological gardens tigers breed readily, and if well cared for will reach an age of twenty years. Captive animals often cross-breed with lions with considerable success. An offspring of a male lion and a tigress is called a liger, while the offspring of the male tiger and a lioness is called a tigon. Such offspring are fertile.

On the whole it can be said that civilisation is a greater threat to the tiger than it is to the lion. It has only recently been given protection, but it may yet be possible to save it from extinction.

Among the smaller of the big cats is the **Leopard.** Few animals can boast as many names, and it is still called panther as well as leopard. No animal has suffered so much at the hands of untruthful story tellers, and even in modern books on travel the greatest ignorance is displayed on the subject. Many authors have leopards attacking their heroes, in Africa, South America and Australia. Many of the stories are complete fabrications and some authors persistently mix up the leopard with the South American jaguar.

A fully grown leopard measures 8 feet long including its tail of 3 feet. The fur is yellow or dark yellow and the whole body is covered in black spots. On the back and flanks the spots form rings and the fur colour inside these rings is darker than on the surrounding fur. In the jaguar there are dark dots inside these rings.

Leopards are found in the whole of Africa and in Asia Minor, Persia, Transcaucasia up to the Caucasus, in India and the Indian Highlands, in China, Manchuria, Siberia and Korea. In view of this wide distribution it is easy to understand why races of leopards differ from each other so strikingly. After all, the difference in climate between Siberia and tropical Africa is very substantial. As one would expect, Siberian and Chinese leopards have much thicker and longer hair than the animals of the tropics.

Black Panther

The most distinctive type of leopard is the so-called black panther. The Indians call it *baghira*. This is neither a separate species of leopard nor a geographical race. It is a colour deviation known as melanism and can appear in leopards of any race. The black colour arises from excess black pigment in the coat. The difference between a black panther and one of normal colour is no more significant than the difference between a black-haired and a fair-haired human being. The offspring of such an animal may be black or of normal colour.

Travellers have foisted on leopards the reputation of being more treacherous than other beasts of prey. This is not true. Like all other beasts of prey the leopard tries to avoid man whenever possible, but when wounded or brought to bay, naturally it tries to defend itself. In the case of the leopard, more so than any other carnivore, people are often guilty of anthropomorphism — which means attributing human characteristics to animals. This is the cardinal error in any study of animals. Human characteristics must never be ascribed to them; for example — magnanimity, faithfulness, craftiness, cunning, et cetera. The leopard is an animal like any other and its activities are controlled by inborn instinct, not by reason. Crawling stealthily after its prey is not reasoned craftiness, but a necessity which is directed by instinct.

One of the leopard's outstanding characteristics is its amazing mobility. It can move fast on the ground or in the tree tops with absolute certainty. In this it resembles the smaller cats. Its style of hunting is to lie in wait in a tree or belly-crawl towards its prey, then strike by means of a long jump. It often carries its prey into a tree and this habit is particularly noticeable in African leopards. By doing this the leopard protects its prey from hyenas and jackals which would otherwise claim their share.

Leopards prey on antelopes, birds, lizards and mice. They also hunt monkeys and will climb after them in the trees. As soon as a monkey sees a leopard it begins to call in alarm and climbs to the topmost branches. Some monkeys will even throw things at the leopard. African leopards prey to a very great extent on the Sacred Baboon. Brehm has recorded:

"Suddenly a great commotion arose among the monkeys and several minutes later we heard a terrible noise from the valley. All the male baboons were proceeding along the rock wall, madly beating the ground with their hands. Some highly excited males began to climb up the wall. Suddenly, a leopard appeared. Paying no attention to the people present, the leopard leaped at one of the baboons. It alighted on the monkey's back rather like a rider on horseback and, ignoring the noise and shouts of the human spectators, rode it down into the valley. The leopard was gripping the monkey's mouth with its claws while its hind legs gripped the victim's back. When they approached our servants the cook took aim with his master's rifle and shot the leopard. Then he killed the severely wounded baboon."

If a leopard has been kept in captivity since cubhood it tames as easily as any of the other cats. Older cubs make a show of resistance and throw themselves against the bars of their cage.

An adult leopard requires 11 to 13 pounds of meat daily and sometimes it is necessary to give it whole rabbits with hair and bones. If properly cared for a leopard will breed readily in captivity and live to the age of twenty years. In captivity, the leopard has been cross-bred with the lion.

The **Jaguar** is another large spotted cat which the older writers often mistook for a leopard. The distinctive markings of the two species have been described already in the chapter dealing with the leopard. Compared with the leopard the jaguar has a larger head and shorter legs. In the matter of size and basic colour the two species resemble each other closely. A characteristic of the leopard is that it carries its tail with the tip turned upwards.

South America is the jaguar's main habitat. In North America it occurs only in the southern states. Its general habits do not differ greatly from those of its relatives. It is an excellent jumper and a skilful climber, spending much of its time in trees. Like the tiger it is fond of water and can swim across the broad rivers of South America.

Rengger, the traveller, has related an interesting story about a swimming jaguar:

"Soon after my arrival in Asuncion, Paraguay, I witnessed an amazing incident in the hunting of a swimming jaguar. The jaguar was swimming from the opposite bank towards our side. Despite having been warned by a native, the three oarsmen, all Paraguians, jumped into a boat and rowed towards the

jaguar. One of them fired at the jaguar from a distance of 6 feet and wounded it. Before they knew what was happening the jaguar had taken hold of the side of the boat and despite being beaten with oars and the butt of a rifle, climbed aboard. Now the rowers had no choice but to jump into the water and swim towards the bank. The jaguar settled down in the boat and allowed itself to be carried away by the current. Only when pursued by another hunter did it leap into the water, swim ashore and disappear in the thickets on the bank."

This incident shows clearly that the jaguar will attack man only when wounded. Otherwise, like all the other cats, it tries to avoid him.

The jaguar hunts close to the water, where it lies in wait for its favourite prey — the capybara — which is one of the largest rodents. But it hunts bigger animals, including tapirs and domestic livestock, and it will take small ones like birds and small mammals.

Occasionally a black jaguar is reported but these, like black leopards, are merely melanistic types. Black jaguars are the most sought after animals for zoological gardens.

In captivity the jaguar settles down as readily as the leopard. The small cubs are easily tamed and can be led about on a leash like dogs. The jaguar breeds in captivity and will cross with the leopard.

In the high mountains of Central Asia lives a close relative of the leopard, the **Snow Leopard.** It is about the same size as the leopard, but quite different in appearance. Its body is covered with long, thick hair. The long, hairy tail is usually about 4 inches thick. The fur is greyish white with conspicuous black spots.

The snow leopard has the same graceful, springing gait as the leopard and is one of the handsomest beasts of prey. In high mountain areas its snow-white coat gives perfect concealment. The animal resembles a piece of grey rock as it lies in wait near a path used by wild sheep and ibexes. Only an occasional twitch of its tail betrays its constant state of alert attention. As soon as the prey comes within striking distance, the snow leopard leaps up as if propelled by a spring and with one mighty jump alights on its victim's back.

Local hunters catch the snow leopard in steel traps which they bait with a kid or a lamb. The leopard is caught in the traps and held by a front paw. Despite its frantic struggles to escape it cannot free itself from the strong steel jaws. When it has tired itself sufficiently the hunter throws a blanket over it and binds it with a strong cord. This is a very dangerous procedure requiring considerable experience and quick reflexes. The hunter secures the leopard's jaws with a muzzle, then he binds its legs and carries it away. It is then transported on horseback to the nearest railway station and from there to some zoological garden. There is a great demand for snow leopards in zoos because of their beauty. Although not rare on its home ground, the snow leopard is one of the most expensive animals to buy because hunting it is difficult and transport from the high mountains costly.

Unlike leopards and jaguars, the snow leopard does not thrive in captivity. Neither the climate nor the unusual food agrees with it. It rarely breeds in captivity and never reaches a great age.

As we have already said the lion, tiger, jaguar and both species of leopard belong to the group of the so-called big cats.

VII 1. *Serval* 2. *European Genet* 3. *African Wildcat* 4. *Large Indian Civet* 5. *Pallas's Cat* 6. *European Wildcat* 7. *Ocelot* 8. *European Lynx* 9. *Jungle Cat*

Now we come to the small and medium-sized cats. However, it is not their size which is important but the arrangement of the hyoid bones, which in the big cats produce a roar. The smaller cats do not roar and their vocal displays are variations of mewing. In addition, they can produce the sound which we know as purring.

In American books of travel the **Puma** is often called the silver lion. Other names are mountain lion, cougar and panther. It is smaller than the big cats and differs from the other large American cat, the jaguar, in having an unspotted coat of rusty brown or silver grey. It is more widely distributed than the jaguar, being found in the far north of Canada and in the whole of North America, as well as in South America, where it reaches down to Patagonia.

There are several geographical races differing in size and colour. The largest race is the **Canadian Puma** which is silver grey. The **South American Puma** is rusty brown.

Like other cats the puma lies in wait in trees or among rocks for its prey. It is an excellent climber and its climbing abilities can best be illustrated by an example recorded in Canada. Hunters drove a young puma on to a high rock surrounded with nets. Only one steep face about 60 feet high had not been covered by the hunters. The puma chose this face as its escape route, threw itself from the top and reached the ground with one tremendous leap. No better example of its ability could be produced.

Young pumas have spotted coats — the spots being large and dark. Pumas taken very young settle down in captivity, tame easily and become attached

Puma

to their keepers. They are bred in all the larger zoological gardens.

The **European Wildcat** is found in Europe, Asia and Africa. It varies considerably over its range and twenty-one geographical races have been described. There is such a great difference between some of the races that earlier zoologists considered them to be separate species. Protection has saved the wildcat in Czechoslovakia, but in Bohemia and Moravia it was exterminated many years ago. In Germany it is confined to the Harz and Eifel mountains, but it disappeared from the Central Alps in the second half of the nineteenth century. From time to time it is still reported in the forests in the neighbourhood of Geneva. It no longer exists in Scandinavia. In the British Isles it is now confined to the mountainous Highlands of Scotland.

The European wildcat is a bigger and more powerful animal than the domestic cat and weighs from 11 to 24 pounds. Its legs are shorter in relation to its body size and the skull is broader with a very

steep forehead. The head of the domestic cat is oblong. The wildcat's colour is grey to yellowish grey and the coat is striped, never marbled. It has a short, thick, shaggy tail, blunt at the tip and ringed with black. The domestic cat has a tapered tail.

In Europe the wildcat inhabits dense forests with plenty of undergrowth and has its lair in tree holes or rock crevices, and sometimes in the abandoned earth of a fox. During most of the year the sexes live apart. In February the breeding season begins and soon afterwards the female leaves the male again. She makes a warmly lined nest for her young and gives birth to her kittens after a gestation period of thirty-three days. The kittens are blind at birth and do not open their eyes until the tenth or twelfth day. The cat is a devoted mother and will face even man in defence of her young. If the kittens are threatened by danger the mother will carry them to another nest. The kittens grow quickly and soon begin to play with their mother and with each other. Like the domestic cat the wildcat is a fastidious animal and the female licks her kittens clean several times each day.

A wide variety of prey is taken, but the main prey species are mice and voles. Therefore, the wildcat fully deserves protection. In Germany wildcats have been introduced into some forests to help increase their numbers. Apart from rodents, the wildcat hunts birds and even lizards. When food is scarce it will attack bigger game, especially when there is a family to be fed. Then, it will hunt hares and cases have been reported of a wildcat killing a roe deer fawn, but this is exceptional.

The wildcat's reputation for untamability is known throughout Europe, including Scotland, where all attempts to tame it have so far failed.

Wildcats are frequently reported interbreeding with domestic cats. The offspring from such a cross are normally fertile and can breed, despite the fact that the domestic cat has not been bred from the European wildcat but from Egyptian ancestors. The cat had been tamed in Egypt as long ago as 2000 B.C., the wild species concerned being the so-called **African Wildcat.**

The ancient Egyptians worshipped both wildcats and domestic cats as sacred animals. They embalmed the bodies of cats and entombed them with the Pharaohs. Even at the present day this attitude to cats persists in Egypt. Owners of hotels, coffee houses and confectioneries keep many cats, which occupy with great dignity special chairs set amidst the guests.

In Scotland the true wildcat is often confused with gone-wild domestic cats. But a domestic cat, however closely it resembles the real type, remains a domestic cat no matter how long it lives a wild, free life. Even when it breeds with another gone-wild domestic cat the offspring remain domestic cats, whatever size they may reach and however fierce they may become.

Although primarily a forest animal in Europe the wildcat survived in Scotland because of its adaptability, and for a long time managed to exist on wild, treeless terrain. Nowadays, with so many forests reaching maturity, it is again an animal of the tall timber.

Unlike the European race, which is said to breed only once a year, the Scottish wildcat breeds twice and there is some evidence that it may produce even a third litter. The first litter, numbering two or

three and sometimes four kittens is born in the first half of May. However, the wildcats' extended breeding season does not necessarily mean that three litters a year are produced. It may simply mean that the Scottish wildcat breeds at any time of the year.

The food of the Scottish wildcat consists mainly of small mammals such as voles, mice, leverets and baby rabbits, but it will also take adult hares, grouse and ptarmigan. Like most big predators it will take whatever it can catch and hold. Its main enemy in Scotland is man, who traps it and shoots it. Golden eagles and foxes may kill the occasional kitten, but apart from man it can safely be said that the wildcat has no natural enemies.

The **Ocelot** is a small, handsome, spotted cat, ranging from South Texas to Brazil and Bolivia. It is larger than the European wildcat, standing about $19^1/_2$ inches tall and measuring $4^1/_2$ feet in length including its tail. Its pale fur is darkly spotted, giving the ocelot the appearance of a small leopard. Because it tames easily and is a most attractive animal, the ocelot is widely kept in zoological gardens.

The food of the ocelot is very much like that of the wildcat. Roe deer fawns are well within its prey range, but it feeds mainly on smaller animals and birds.

The **Jungle Cat** is also larger than the wildcat and has a yellowish-grey unspotted coat. Its tail is short and about one third of its body length. It occurs mainly in dense reed beds and bush areas close to rivers and lakes. It is found in Africa, in the valley of the Nile, in Asia Minor to the Caucasus and Turkestan, in India, Burma, Thailand and Ceylon. It is an accomplished jumper and swimmer. When hunting, it crouches down in a reed bed and lies in wait for its prey. Water fowl form its main prey. In captivity it breeds freely and soon becomes friendly with its keeper.

The **Caracal Lynx** is slightly smaller than the jungle cat, and measures about $27^1/_2$ inches in length. It is also a much more slender animal. This species inhabits the dry regions of Africa south of the Sahara, and the deserts of Central, Southern and Near Asia.

Very little is known about the caracal in the wild state. It is most likely to be seen in desert country sparsely covered with bushes or dotted with rocks and scree. During the day it hides in hollows under rocks or under tree roots, and quite often it will occupy the lair of a porcupine. It hunts only at night and is said to be most dexterous in catching animals like jerboas and gazelles. It also preys upon birds and large insects. In summer it makes regular visits to a watering place. In India the caracal has been trained since ancient times for the hunting of

Caracal Lynx

Clouded Leopard

a variety of animals and is said to be easily tamed.

The **Clouded Leopard** is found in Southern Asia and Indonesia. Its usual colour is grey or yellowish grey, with large, dark-brown spots edged with black.

The clouded leopard measures about 3 feet in length. It has a comparatively long tail. It is short-legged and lives mainly in trees. Birds are its main prey, but it is reputed to take anything it can catch and hold.

The **Golden Cat** is a smaller species resembling the leopard and there are several colour phases. The most usual colour is reddish brown, with light flanks and tail and several dark spots on the throat and chest. Some specimens, however, may be entirely chestnut brown or grey. This species has a comparatively small head.

Golden Cat

Central and West Africa are the habitat of the golden cat. It is a typical ground animal and does not climb trees. It lives in rock fissures or holes or in the deserted dens of other animals, and preys mainly on birds and small mammals.

The best known representative of the lynx family is the **European Lynx** which is easily recognised by its stump of a tail which is tipped with black. The tips of its ears have long tufts of hair and the cheek hairs look like whiskers.

The lynx is found in Europe, Asia and North America. Over much of Europe it has been exterminated and to-day is found mainly in Poland, U.S.S.R., Finland and Sweden. In Central Europe it is found only in Czechoslovakia where it is protected by law. As a result of this protection it is again spreading out into other areas where it had been exterminated. Like so many large predators the lynx was hunted because the people did not understand the important place it occupied in nature. They saw it only as a killer of roe deer and other species. The main agent in its extermination was the steel trap; the lynx, like all the cats, having very little trap sense. Outlawing of these traps has resulted in some increase in the numbers of lynxes.

Shooting the lynx is very difficult as even the most experienced hunters have great difficulty in getting close to the animal. Because of its sharp sight and sensitive ears the lynx is warned of a man's approach while he is still a long way off.

Dr. Komarek, the well known zoologist, has recorded his first meeting with a lynx as follows:

"Early in the morning I was sitting in my hideout. It was almost six o'clock when the sun rose. Suddenly I became aware of something moving in the beech undergrowth and looked down expecting to see some roe deer. I saw a reddish shape approaching me through the dense undergrowth and, suddenly, there the lynx was, close to my hideout. At first I thought it was a sheep dog, then, when it appeared on the edge of the forest path, I realised it was a lynx following my tracks. It was a beautiful animal about 3 feet long and reddish-coloured against the green grass; the black ear tufts were erect and its white whiskers framed its face; its paws were as broad as human fists. It was now sitting just below me at a distance of not more than 10 feet.

"Silently I reached out for my camera which was lying opposite me. However, the slight sound caused by the rubbing of my soft coat alarmed the lynx. Although it had been completely at ease a moment or two before, it now raised its head at once and its large yellow eyes stared directly into mine. The stare lasted only a moment, but it was long enough for the lynx to realise what it was facing. It leapt up and disappeared along the path in tremendous low bounces.

"Now I could breathe again, and my first thought was for the deer fawns near my hideout whose fate I now considered to be sealed. I looked at their hiding place and there they were crouched contentedly, side by side. Nothing had happened to them. At that moment I heard steps and a young roebuck came along the path, his muzzle to the ground, sniffing at the tracks of the lynx. I expected him to flee for his life, but I was again deceived, which goes to show that people have many wrong notions concerning the co-existence

European Lynx

of animals in the forest. The roebuck was not frightened in the least; on the contrary he sniffed with the utmost thoroughness at the place where the lynx had stood a few moments before and then slowly continued on his way. I was the one who had been most excited at this encounter with the lynx."

Dr. Komarek then goes on to explain why he had been so surprised at seeing this lynx. He had been visiting the area for years and neither he nor any of the foresters had ever found as much as the track of a lynx. This shows that the lynx leads a secretive life.

The lynx lives mainly in dense forest, and has its lair in rock cavities or under fallen trees. If a lynx moves into an area from which its kind have been absent for a long time it can cause considerable damage to roe deer. Being unfamiliar with the lynx, the deer at first fall an easy prey and it takes time for them to adjust to its presence. In such cases the lynx will kill more deer than it needs for food. So we often find dead roe deer from which the lynx has eaten nothing. Once the deer are accustomed to the lynx's presence, they become more alert and fewer

animals are killed, so that predation becomes normal and has little effect on deer numbers. It was found, indeed, that the most powerful roe-bucks occur in regions where lynxes are settled, so it is obvious that the lynx, like other big predators, hunts the weak and the aged animals.

The large Siberian and Canadian lynxes, which weigh up to 120 pounds (the European lynx weigh only 66 pounds), hunt prey up to the size of reindeer and stags, but they also kill birds and will take even mice, hares and other small mammals.

The lynx usually likes to lie on a rock, or the branch of a tree, and wait for its quarry to appear; then it leaps on to its victim's back, bites through the arteries, and breaks its neck. It will play with smaller prey as a cat does with a mouse, tossing it into the air, pouncing on it, snarling at it and rolling over on its back with the prey held aloft.

Lynxes mate between January and March. After a period of ten weeks' gestation the female gives birth, usually in April or May, to two or three blind cubs in a warmly lined lair. The cubs' eyes open after ten days. Like all the cats, the lynx is an excellent mother and keeps her kittens clean and warm. If danger threatens she will carry them away to a safer place.

The young lynx is easy to tame and will follow its owner like a dog. However, if it sights a possible prey, it immediately becomes excited to the extent of ignoring its master; and when in possession of prey, will defend it violently against him. If well cared for, a captive lynx may live to the age of twenty years.

Pallas's Cat resembles the European wildcat, but is smaller. It is a handsome animal with long, yellowish-grey fur and pronounced whiskers. The fur of its back is faintly striped with a darker shade. This species inhabits the deserts and upland steppes of Asia and lives almost exclusively on small rodents. It occupies the burrows of marmots or other mammals and lies up in rock fissures.

Pallas's Cat is often kept in zoological gardens, but is seldom seen by the public as it sleeps out of sight during the day and does not become active until dusk.

The **Serval** is larger than the European wildcat but smaller than the lynx, and has a pale, dark-spotted coat, a slender body and strikingly long legs. It inhabits Africa, living on plains or the jungle fringe, and feeds mainly on birds, stalking up to them and then catching them by leaping at them as they rise into the air. Because of their handsome appearance servals are widely kept in zoological gardens.

The **Cheetah** is about the same size as the leopard but has strikingly long legs, a small, round head and a long tail. The pupils of its eyes are circular and it differs from all the other cats in not having retractile claws. The cheetah is found on level open ground in India, Iran, Afghanistan, Baluchistan, Turkmenistan, Arabia and Africa.

In its general conformation and movements the cheetah resembles a greyhound rather than a cat. Unlike some of the other cats it does not climb trees, but it is an excellent runner and has been precisely timed by modern instruments at a speed of 75 miles per hour. Thus it is the fastest land mammal and its speed is outstanding when compared with that of the greyhound which attains a speed of

68 miles per hour. Antelopes reach a speed of 60 to 68 miles per hour and zebras from 37 to 40 miles per hour. The highest speed attained by man in the 100 yards world championship was $22^1/_4$ miles per hour. Of course the cheetah can hold such speeds for only short distances. On a long run it tires quickly so it has to catch its prey in the first sprint or lose it.

The cheetah hunts its prey by stalking as closely as possible, then leaping forward in a great burst of speed to overtake it. The cat then throws its quarry to the ground, and kills it. It chases mainly antelopes, gazelles and other fleet animals and is perfectly designed to do so.

Not much is known about the cheetah's habits in the wild state, which is surprising when we consider that man, especially in India, has been using it for a long time in the hunting of gazelles and antelopes. The first reports of tame cheetahs being used for hunting date from the Third Millennium B.C. Large numbers used to be kept by Indian maharajahs, and reliable sources suggest that up to one thousand animals were kept at their courts.

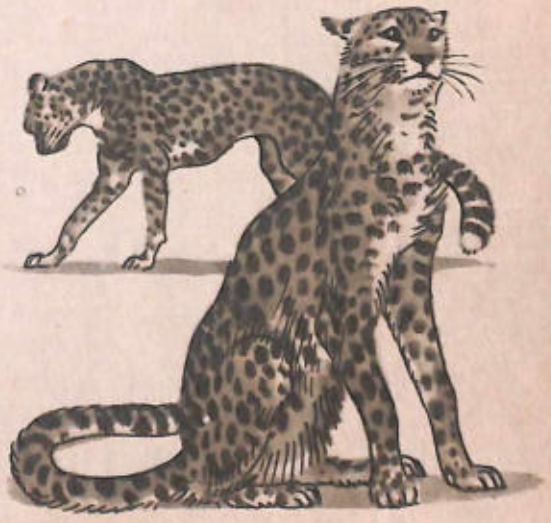
Young cheetahs caught wild have first of all to be tamed, then they undergo a training period of five or six months. Older animals caught in snares can also be tamed and trained to hunt.

Hunting cheetahs are carried in special light carts where they are kept on leashes by their attendants. The cheetahs are hooded in the same way as falcons — their heads are covered so that they are unable to see. Game is not so afraid of teams pulling carts as of a single hunter, so the team can approach within two or three hundred paces of a herd before the animals take notice. Once the hunters are in a favourable position, the keeper removes the cheetah's hood, points out the quarry and sends the cat off in pursuit.

As soon as the cheetah sees an antelope it jumps down from the cart, stalks forward at a crouch, then breaks into a run and covers the final 50 to 100 yards at high speed. Overtaking its quarry, it leaps on to the animal's back and breaks its neck. The hunter follows quickly on horseback and cuts the throat of the dead animal, the blood from which is caught in a wooden bowl and given to the cheetah. The cheetah's hood is then replaced and hunting continues.

It sometimes happens that the game discovers the cheetah while it is still some distance away, and in such cases hunting often ends in failure as the cat will break off the chase within five hundred yards.

Surprisingly the cheetah does not thrive in captivity over a long period, even in the best zoological gardens. Nor is it as long-lived as the other cats. Confined quarters do not give the cheetahs the freedom of movement which seems to be so important to their welfare. Attempts at breeding them in captivity have always failed, even in their native country. The



Cheetah

reasons for this failure are still not known but may be due to our lack of knowledge concerning their natural way of life. All cheetahs kept in captivity have been caught up as young animals in their natural surroundings. As the result of all this, the cheetah is more valuable than the other cat species.

CIVETS, GENETS AND MONGOOSES
Family VIVERRIDAE

To this family belong the Civets, Genets and Mongooses. These are all small mammals, long-bodied and short-legged, resembling martens. However, their body structure shows that they are related to the cats. Many civets have the retractile claws of the cat family.

Civets are important mammals because they reveal how present-day carnivores have developed. They are certainly the oldest type of carnivores and the species existing to-day are actually relics of an extinct family. This is shown best by their teeth, which number forty. Most cats have thirty. The molars of the civets closely resemble in shape the molars of carnivores that became extinct millions of years ago. Nowadays similar molars are found only in the insectivores and marsupials.

Formerly civets were much used in medicine. In ancient times a rare physic known as viverreum was produced from the male's abdominal gland.

The **European Genet** is smaller than a cat and has semi-retractile claws. It is a handsome animal, light yellow in colour with black mottling. Its long tail is striped with black. This species is found mainly in Africa but occurs also in Europe — in Spain and the south of France.

Genets prefer rocky slopes with dense thickets and spend the day in rock holes or hollow trees. They do not dig burrows. They become active at dusk when they emerge to hunt. With their pointed snout they sniff in all directions and their black sparkling eyes can detect the slightest movement. They hunt birds, mice and lizards, and suck the eggs of birds. Their favourite prey is rats and they will enter human dwellings to hunt for them. However, the truth is that they are just as likely to enter hen-houses or pigeon-lofts where they can do as much damage as any fox or polecat.

Joseph Volf has written of the breeding of these animals in captivity:

"When in 1954 the first genets were born in the Prague Zoological Garden, this was considered a unique occurrence. However, since that time the same female has produced a further four litters, totalling nine young.

"Genets in captivity are usually amiable. They will even accept newcomers to their cage without any sign of enmity and feed with them from the same dish. They are not difficult about food. Apart from fresh lean meat, they can be given a sparrow, a pigeon, or mice every second day. Their spacious cage, which measures 3×3×2 yards, contains a hollow tree trunk with wide-spreading branches. The young animals tame quickly. If the Greek historians were referring to the genet when they spoke of the 'little leopard', then these animals must have been domes-

ticated in ancient times and used for catching mice."

Genets tame easily if taken young enough and people even now keep them like cats for catching rats and mice. Although they are handsome creatures and meticulous in their personal habits, they are not very pleasant companions in the house as their scent glands leave an unpleasant smell everywhere.

The **Large Indian Civet** does not differ substantially from the other species in general appearance. Unlike the mongoose, it has very short hair. Its basic colour is brownish-yellow but the hair of the body is spotted rust-red. There are four black stripes on the neck and the tail is black-spotted with a black tip. The civet measures about $31\frac{1}{2}$ inches, including its tail of 22 inches. Weight varies from 17 to 26 pounds. This species is found in India and in South and Central China. Birds and small mammals are its main prey but it will also eat snakes, frogs and a variety of fruits.

Civet, which is the name given to the secretion of the animal's anal gland, used to be in great demand, and in India special farms were established for the breeding of these animals. Although civets are very voracious (at these farms two hundred civets required four oxen per day), breeding them for the secretion of their anal glands was a highly profitable business. Every fourth day $2\frac{3}{4}$ to $3\frac{1}{2}$ ounces of this substance were obtained from each animal and used mainly for the production of perfumes and medicines which were in great demand.

The **West African Civet** is a smaller animal than the Asian species. It is, however, more robust and has blackish-brown spots on its beautiful ash-coloured fur. Along the length of its back the hair forms an obvious mane. This species is found in Africa.

The **Binturong** resembles a small bear rather than a civet. It measures about 59 inches in length, half of which is tail. The tail is prehensile and acts as a fifth limb so that the binturong can cling to, and hang down from, the branch of a tree. It has rough, rather long hair which is almost black in colour. Despite its size it has remarkably weak teeth and this is reflected in the kind of food it eats — fruits, bamboo shoots, insects, frogs and small mammals.

When hunting, the binturong moves slowly and silently, treading on the soles of its feet like a bear. Even its voice resembles the growling of a bear.

The range of the binturong extends from the eastern slopes of the Himalayas southward via Burma and Malaya to Sumatra and Java.

Binturong

A further member of this family is the **Egyptian Mongoose,** or **Ichneumon,** which is larger than the domestic cat, although at first sight it looks smaller because of its slender snake-like body and short legs. A fully-grown mongoose will measure up to 39 inches in length, including its tail, and weigh from 15 to 19 pounds.

The Egyptian mongoose is easily distinguished from the genet, its coat being uniformly brownish to olive grey in colour and unspotted. The flanks are covered with long pendant hair which hides the short limbs, so that the mongoose sometimes appears to be legless. Its claws are not retractile and there is no abdominal gland. This species is found over most of Africa and in Spain.

The word ichneumon (the second part of the Mongoose's Latin name), means "snooper", which accurately describes the animal's movements and its way of life. In the evening it wakes up and creeps through the rocks. Like the snake, it creeps through high grass and reeds. Like a cat, it will lie in wait at rat-hole or mouse-hole. When hunting birds it will leap into the air and catch them as they rise in flight. It seeks out nests on the ground and eats eggs and nestlings. Unlike the genet, it is a capable burrower and will excavate day-burrows. When hunting it usually kills more than it requires and is often content to eat only the brains of its prey.

Egyptian Mongoose

Many legends have accumulated concerning the life of this mongoose. The ancient Egyptians sometimes called it Pharaoh's Rat, worshipped it as a sacred animal, embalmed its body and entombed it with kings. The ancients recognised the mongoose's ability as a hunter and killer of venomous snakes, and to this day Egyptians use them for this purpose. At one time it was considered a miraculous animal and even credited with the ability to kill crocodiles. It was said to creep into the mouth of a sleeping crocodile and bite its way through to the reptile's heart. Many modern Egyptians still call the mongoose a benefactor of the human race.

Modern science has been able to confirm only one of the ancient legends, which is that it really does kill venomous snakes. In hunting snakes the mongoose displays considerable courage, because it is not immune to their poison and must overcome the reptile entirely by speed and dexterity. As soon as the mongoose sees a snake it becomes highly excited. It bristles and darts to the attack at once. The snake usually takes up a defensive position with head raised, and this is exactly what the mongoose is waiting for. It leaps in with incredible speed, catches the snake by the head and breaks its neck

with its sharp teeth. Then it proceeds to eat the snake.

The Egyptian mongoose is often kept in zoological gardens and is fed on mice, raw meat and pigeons. It will live in captivity up to the age of fifteen years but does not usually breed. The gestation period in this species is two months and the usual litter size is two young. The male helps in the rearing of the family and under natural conditions has been observed taking charge of the young.

The **Banded Mongoose** is the ichneumon of India. Like its Egyptian relative it has always been held in great esteem in India and became world famous as one of the animal stars of Kipling's *The Jungle Book*. This species is smaller than the Egyptian mongoose, measuring only $15^3/_4$ to $19^1/_2$ inches in length, but it is an equally accomplished snake-killer. Its body colour is grey, almost silvery, but its limbs are almost black. The colour of its face often changes to red.

The **True Meerkat** is a small, attractive animal about $19^1/_2$ inches in length, half of which is tail. With its prolonged slender muzzle it looks rather like a dog. The front and hind feet have four toes, and the forefeet have powerful claws for digging. The meerkat's smooth, short fur varies in colour from grey-brown to whitish-grey with a yellowish tinge. On its back it has from eight to ten transverse stripes. This species has excellent eyesight. When alerted it crouches to look around and can see an approaching bird of prey long before a human being can do so. It is said to be most inquisitive.

The true meerkat lives mainly on animal food — insects, eggs, small vertebrates and carrion. "It scents its food,"

True Meerkat

says Brehm, "and therefore it constantly sniffs in every nook and corner. If it finds anything interesting it takes hold of it with its front paws, sniffs at it, turns it round several times, and if it finds that it is something edible, begins to eat it. It holds the food in its front paws and conveys it to its mouth that way."

On many farms in South West Africa, tame meerkats can be seen running about quite freely. There they are even more courageous than under natural conditions and will bite at the legs of any strange dog, although they are on the best of terms with the dogs living on the farm. Meerkats cannot be kept as household pets because they are not clean in their personal habits and have an unpleasant smell.

The **Fosa** is an animal whose correct classification puzzled zoologists for a very long time. In general appearance it looks like a cross between a cat and a civet. At first glance it resembles a cat, particularly in its expression, but its ana-

Fosa

tomy suggests that it belongs to the family of civets. However, it is classified with neither the civets nor the mongooses, as it evolved independently of them and very likely much earlier.

The overall length of the fosa is 6 feet, half of which is tail. It has short, coarse, yellowish-red hair. The teeth are a combination of the cat's and the civet's while the curved retractile claws are like those of the cat.

The fosa is found in Madagascar, where the native population wages constant war against it because of its predation on domestic livestock, for example, poultry, lambs, hens and turkeys. Nothing is safe from it. It hunts at night and is even said to pursue the semi-apes in the treetops. On the other hand, it is easy to tame and becomes very friendly in captivity. One fosa lived for seventeen years in the Berlin Zoo and was the Director's pet.

HYENAS
Family HYAENIDAE

The Hyenas form a small family of medium-sized carnivores which are closely related to the civets and cats, although their general appearance suggests a relationship to the dog.

The hyena's forelegs are longer than its hind legs so that its back slopes down towards the tail. It is a powerful animal with a short head and unusually powerful teeth which are capable of breaking up even the thickest bones. By means of special masticatory muscles the hyena can exert immense pressure with its jaws and thus crush bones as though they were made of wood; a feat which would defeat the teeth of the lion or the tiger.

Nowadays, hyenas are found only in the tropics although in prehistoric times they were also found in Europe.

Aard-wolf

The **Aard-wolf,** like the fosa, has given rise to much argument about its classification. Formerly it was classified with the civets, although some zoologists are still of the opinion that it should be in a special family. It differs from other hyenas in being smaller and having five toes on its forefeet, whereas the hyenas have only four toes on forefeet and hind feet. The forelegs of the aard-wolf are longer than its hind legs and its back slopes markedly towards its rump. It has long, thick hair, a bristling mane and

a shaggy tail. The aard-wolf measures $31\frac{1}{2}$ inches in overall length, which includes its tail of 12 inches. The main colour of its hair is a dirty yellow and it has several dark transverse stripes on its flanks.

This species lives in the dry regions of South and East Africa with the exception of the coastal lowlands. According to Stevenson-Hamilton, it is found up to altitudes of 1,500 feet above sea level. It inhabits open sunny ground overgrown with scrub. During the day it hides in rock fissures or under the roots of trees or it may use the abandoned lair of a meerkat. At dusk it comes out to hunt. Its main food consists of insects, particularly termites, beetles and locusts, but it will also eat small mammals, young birds, eggs, snakes or carrion.

Sclater, who examined about fifty stomachs of this species, found only termites in them.

The aard-wolf breeds in November and December and has usually two to four young at a birth. There is only one litter a year. Some years ago an aard-wolf was kept in the Prague Zoological Garden where it lived for only a short time. According to Flower, a specimen lived at the London Zoological Garden for thirteen years.

The **Spotted Hyena** stands about $31\frac{1}{2}$ inches tall at the shoulder and weighs from 110 to 165 pounds. In general shape and size it resembles a strong dog. Its whitish-grey or yellowish fur is spotted, particularly on the flanks and thighs, and its striped tail has a black tip. This species is found all over Africa, south of the equator.

The name hyena has an unpleasant ring to the human ear because it evokes

Spotted Hyena

the idea of a cowardly, skulking, cunning animal, that will dig up human corpses. Actually hyenas are of tremendous importance in nature. With the vultures they make up nature's sanitary corps in tropical regions, devouring all the carrion left over from the feasts of the large carnivores which would otherwise decompose and pollute the air. High temperatures cause rapid decomposition of corpses and putrefying bodies are the breeding ground of millions of flies which then spread a variety of diseases. Therefore the best protection against these diseases, which occur from time to time among wild ungulates, is the rapid removal of all carrion. The hyena is specially designed to perform this highly important work, so we should not look upon it with such contempt.

In fact, when we become better acquainted with the hyena, it does not seem nearly such an unpleasant animal. If one is taken young it becomes as tame as a dog and keepers of hyenas have declared that they are among the most charming and amiable of animals.

Unfortunately, not much is known about the life of hyenas under natural

conditions as they are active mostly after sunset when they set out in search of food. As a rule, they hunt in small packs consisting of the two parents and several young. They live mainly on the remains of dead animals, and hyena droppings contain a high proportion of finely crushed bones. However the animals also hunt live prey, generally the young of other animals, and in doing this they often display great courage. Here is what Machulka has to say about hyenas:

"I moved my expedition from Khartoum to Es-Suki and so shortened our march to the hunting grounds. We unloaded the expedition before nightfall and camped in front of the station, a small building accommodating two or three railway clerks. We stacked our luggage in a neat row. Then we drove a number of sticks into the ground and connected them with a rope to which we tied most of our riding donkeys and two horses. My men made a fire about the middle of this line and cooked their meal, talking and laughing all the time and making a great deal of noise. I was lying in the open behind the heaps of luggage which separated me from the men.

"It was a dark, warm and calm night. Suddenly, there was pandemonium among the animals. My men jumped up and began to shout wildly. I ran towards them and there in the light of the lantern I was amazed to see what the teeth of a hyena could do. The donkeys had been tied to the rope in a line. With one bite the hyena had torn out almost half the thigh of the donkey second from the end of the line — the hyena had selected the strongest animal. The donkey had been standing four paces from the fire and from the shouting men round it, and was almost in the shadow of the station building. Behind the station a railway truck was being noisily loaded, yet the hyena had come in to attack, and half of the donkey's thigh had disappeared with it in the night. To pursue the marauder in the dark was quite impossible."

However, the traveller adds that such cases occur very rarely. Only extreme hunger will drive the hyena to make such a daring attack, and no case of a hyena attacking people has ever been recorded although some writers continue to say so. Domestic livestock is attacked only by the spotted hyena.

Brown Hyena

The **Brown Hyena,** or **Strandwolf,** is the rarest species. It is usually a solitary animal and is seldom seen in packs. Its original habitat was East Africa, from the Southern Sudan and Somalia to South Africa, and thence north to Angola. Perhaps it was never numerous, but to-day it is certainly extremely rare. It is uniformly brown in colour and only its limbs have a few light spots. This species differs from the others in its dorsal mane which is much smaller and, unlike that of the aard-wolf, spreads down over the flanks.

The **Striped Hyena** is smaller than the

Spotted and is a much shyer animal. It has long fur which is whitish in colour with black stripes. So far there has been no record of this animal attacking large living prey.

The striped hyena inhabits Africa, the Near East, Central and South Asia and has spread into the U.S.S.R. In its general habits it resembles the spotted hyena. Although not difficult to keep in zoos, the striped hyena is not often seen there. It will thrive on poor quality meat but requires large bones. Given proper care it will breed in captivity.

The gestation period in this species is three months and the litter size varies from one to three young which are dark brown in colour. The mother is very attentive to her family and when danger threatens she will carry them to a safer hiding place.

Few people realise how easily the hyena can be domesticated. Brehm has described his experience with tame striped hyenas:

"A few days after our arrival in Khartoum, we bought two small hyenas which were about half the size of a dachshund. They were covered with very soft, dark-brown underfur. Although they lived for some time in human company, they were still not very well behaved. We locked them up in a stable, where I visited them daily, and within three months they became so tame that I could play with them

Striped Hyena

like dogs. They became more lovable every day and were almost happy to see me. When they were half-grown they began to behave very strangely. As soon as I entered they rose immediately and expressed their pleasure by howling, jumping on to me, placing their forefeet on my shoulders, sniffing my face, lifting their tails straight up and projecting their rectum 2 inches from the anus. I got this type of welcome each time I visited them, and I soon discovered that their behaviour was an expression of joyful excitement."

Brehm adds, however, that the taming of his hyenas was not accomplished without corporal punishment. In the early days they used to bite him and even bit his native servants whose wounds took four weeks to heal.

WOLVES, FOXES, COYOTES, ETC.
Family CANIDAE

The members of this family are small or medium-sized animals with strikingly elongated muzzles, and all of them are easily recognised. They have five toes on their hind feet, and four and a vestigial fifth on the forefeet.

All the Canidae have a large number of teeth, usually forty-two, with well developed canines and incisors. The molars have broad crowns. Although their diet is often

mixed, it is mainly carnivorous, and this is reflected in the structure of their teeth.

In the Canidae the most perfectly developed sense is that of smell, which is superior to that of all other mammals. Domestic dogs of the gun-dog breed, for example, can follow the trail left by game wounded some time before. The dog's sense of smell can even help it to recognise its master's change of mood, because man, like other animals, perspires increasingly with his degree of excitement. Because its sense of smell is highly selective a dog can sort out even the finest nuances of smell and judge whether somebody is agreeable or disagreeable to its owner. If this seems an incredible accomplishment, it is a fact well established by much experiment.

The Canidae also have excellent hearing and a dog can hear sounds beyond the range of the human ear. For this reason they can be trained to the so-called Silent Recall, which is a whistle inaudible to the human ear.

The eyesight of the Canidae is not so good, nor is it selective. It is not nearly as well developed as that of cats. The dog cannot distinguish colours so it lives in a black and white world with shades of grey. In other words, it sees the world as the human eye sees a monochrome photograph.

If we compare the Canidae or dog family with the Felidae or cat family, we have to admit that the dogs cannot match the cats' elegance of movement. They cannot make such great leaps as cats; they are not so lithe and, almost without exception, are incapable of climbing trees. But they excel in running, being able to attain considerable speeds as well as displaying great stamina. All of them are good swimmers.

When they become excited or over-heated, all the members of this family pant with their tongues extended. This is their way of cooling down and it is not true that the dog shows its tongue when it is thirsty. In the Canidae the sweat glands have no perspiratory ducts to draw off the sweat from the body. Human beings, when hot or afraid or under great mental stress, sweat freely though the skin. The dog has to sweat by panting with its tongue hanging out.

Most members of this family live in small groups or packs, each group usually consisting of a single family. In exceptional cases a pack is made up of several families which have joined together. The dogs are in fact highly social and it is probably because of this quality that men chose the dog for early domestication. Nowadays we can hardly imagien human society without the dog.

Probably the best known as well as the largest member of this family is the **Wolf,** which inhabits great tracts of Europe, Asia and North America. There are a great many geographical races of the species, differing in size, shape, colour and other characteristics. For example, the wolves of Slovakia are greyish-brown, while the northern wolves of the tundra have a greyish-white coat. The wolves of the steppes are almost rust-coloured and have conspicuously long legs. Forest wolves, on the other hand, are rather darker and have shorter legs. In the size and shape of its body, the wolf very closely resembles the German shepherd dog, or wolfhound, known as the Alsatian in Great Britain.

The mature dog wolf will measure 5 feet in length including its tail, and weigh from 88 to 110 pounds.

If we compare the head of a wolf with

that of a wolfhound, we shall find that the wolf's head is always larger. Unlike the dog, the wolf always keeps its tail down and does not raise it even when walking. The chest of the wolf is flattened on the sides and oval in shape, whereas that of the dog is almost round. The elbows of the wolf always turn inwards while the elbows of the dog always turn outwards.

No animal has given rise to such a literature of half-truths and falsehoods as the wolf, and it has indeed been badly served by its publicists. For example, it is mere legend that the wolf is highly dangerous to man, and modern zoologists have not been able to discover a single instance of a wild wolf attacking a man. What can be said with complete truth is that the wolf has many characteristics in common with the dog and is one of its ancestors, if not its only one. Scientists have long argued over the origin of the dog, but we can now say with near certainty that its one proved ancestor was the wolf. Dog and wolf will interbreed freely, and in Alaska such cross-breeding is general practice because puppies from the cross make the best sled dogs. They are immensely strong and have great powers of endurance. It is, however, quite impossible to cross the dog with certain other members of the Canidae such as, for example, the fox, although from time to time it is claimed that this has been done.

Let us take a closer look at the wolf's way of life and compare it with that of the domestic dog. In the first place, wolves are highly sociable and the normal unit is made up of the members of a single family. In winter, however, several families may join together to form a bigger pack. The leader of such a pack is the strongest male and he must fight hard to hold his dominant position. It sometimes happens that dog wolves fight so furiously that one of them is severely wounded and dies, but fights to the death among wolves occur more frequently in the human imagination than in real life. It is no part of nature's plan to destroy the strongest members of the species.

The members of a pack are obliged to respect the leader, and they show their respect in various ways. For example, a subordinate male has to lick the leader's muzzle whenever he meets him, and it is an interesting fact that tame wolves and dogs behave in a similar fashion towards man. It is not therefore a manifestation of pleasure when a dog jumps up on his master to lick his face or touch his mouth with its nose. By doing so it is merely expressing its subordination, and wolves behave in identical fashion.

The dog has inherited from the wolf yet another habit, or rather instinctive action. Wolves mark the boundary of their territory with their urine, using such things as rocks, tree-stumps and tussocks. The dog has retained this habit and can easily be observed spraying stones, cor-

Wolf

ners of buildings and trees within its home area.

The vocal range of the wolf is much more limited than that of the dog and, in the wild state, wolf calls are rarely heard by human ears unless an observer spends time on their range for this specific purpose. The loud howling of wolves is characteristic of the mating season, which is in midwinter, usually February.

After sixty-three days' gestation, the she-wolf whelps from four to six and sometimes up to nine blind cubs in a warm burrow. For the first few days the bitch wolf stays with them constantly and is provided with food by her mate. The cubs open their eyes some time between the tenth and twelfth day and their mother still spends most of her time lying up with them to keep them warm. When her milk supply has dwindled to a mere trickle the cubs begin to run about and go hunting with the dog wolf. In the early days the parent wolves feed the cubs on partially digested food which they regurgitate for them. Later on, the cubs are given small prey entire or larger prey in dismembered portions.

The young wolves remain with their parents for two years, although when the bitch wolf has another litter of cubs she will drive out the young of the previous litter for a short time. The wolf family is the nucleus of the pack and the animals spend all their lives and do all their hunting in larger or smaller units. Generally speaking, the wolves hunt at night; and only in winter or when they are feeding growing cubs are they likely to be encountered by day. Much work has been done on the wolf in North America by Murie and others, and it has been shown that the bachelor dog wolves will carry food to a bitch with cubs.

During the summer months wolves hunt a wide range of prey, and stomach analysis has revealed fruits, buds, lizards, mice, frogs and other small mammals. At times they will eat dogs. For the remainder of the year, as well as in summer, they hunt the larger hoofed animals such as deer, and they can sometimes become a pest by attacking domestic livestock.

In North America the wolf packs will follow the migrating caribou. In any case they hunt round their vast territory, making regular circuits and working back to their starting point. Like the majority of this family, they are excellent runners, noted for their tremendous stamina. By stalking them it has been discovered that a pack in winter will cover from 25 to 50 miles in one night.

When a wolf pack is hunting, the individual members work together as a team. In mountainous country they will always try to drive their quarry downhill into the valley and preferably into a creek or some bottleneck among rocks. If they are running a line in deep snow, the members of the pack take turn about at leading because the deep snow soon slows down the leading animal and the whole pack would lose pace if he remained there all the time. Because of this, not even the best runners can escape the steady, tireless, machine-like precision of the wolf pack. When run to a standstill the hunted animal will often offer resistance to the wolf pack, and sometimes a strong stag or elk will succeed in smashing the skull of one or more members of the pack, but the wolves finally succeed in pulling the animal down and killing it.

Sometimes the wolf pack will split up during hunting, one group hiding in ambush while the other members drive the quarry to them.

It has already been said that there is no authentic instance of a wolf attacking a man. Russian and American hunters have, in fact, often said that they would welcome such an attack because it would make it easier for them to kill wolves, which is not an easy task except perhaps by poisoning. The wolf is an alert animal and makes a point of avoiding man. It is also extremely wary and distrustful of all his works and is most difficult to catch even in the best camouflaged steel traps.

Doctor Komarek, who has lived for a long time among wolves, has written about the so-called wolf menace as follows:

"In very severe winters when there is a great deal of snow, we can expect with certainty to read reports about wolves in all the newspapers, especially round the New Year. The head of a household will read to his frightened family about a certain village in the Carpathian Mountains where people were attacked during the day by a pack of wolves numbering 200 animals. The people had to lock themselves up in their houses and wait till troops arrived to drive away the savage beasts and deliver the village. Or they will hear how a brave farmer caught a wolf in his cottage, fought with it and put it in chains.

"I am quite certain that all these wolf stories originated in the Balkan countries. If you visit a Balkan country and enquire about wolves, almost everyone you speak to will cross themselves. Somewhere, they will tell you, in a certain village, the wolves devoured a priest who was rushing to give the last sacraments to a dying person, and all that was left of that ill-fated priest were his boots. Another story goes that a grandmother had been carried off one evening and all that could be found of her later were her artificial teeth. But if you try then to discover the village where the unfortunate priest was devoured, or the house where the old woman lived, you will never come upon either."

Wolves of course are not confined to Eastern Europe and Asia. They also inhabit the Arctic regions and North America, and there is a vast literature concerning them. Many romantic writers have written stories depicting the life of trappers and gold diggers in the North American wilderness, and although these writers have not considered the truth of too much importance, not one of them has frightened us with stories about wolves. Serious and experienced people who have lived most of their lives in the Canadian forests laugh about the stories they hear of European wolves, yet the North American animals are much more powerful and venturesome than their European relatives.

Therefore, it appears that wolves which attack people are somehow confined to Europe. It is difficult to understand why people always seem so ready to believe stories about wolves, told by people who have never seen one, instead of trying to get at the facts provided by people who have spent much time studying them. Nothing is easier than to find out from foresters and game wardens who have lived with wolves about their experiences with them. Not one of these men has ever written or spoken a word about being attacked by wolves or having had to defend himself against them; nor are you ever likely to read anywhere about a wolf devouring a forester in mid-winter. These people go through the forest alone, and without fear, at all times, and if you spoke to them you would soon learn that there is nothing they would like better

than to be attacked by a wolf as this would make it easier for them to kill them. As a matter of fact, nothing is more difficult than to stalk within shooting distance of a wolf.

One zoologist, who has been living for many years in wolf country where wolves prey on the game herds, has always been unsuccessful in his winter hunting expeditions in search of them. At the same time, the wolves were so hungry that they were sneaking close to villages at night and killing pigs. This zoologist has reported seeing four wolves sneaking in deep snow along a ridge which he had just crossed. When they reached his trail they stopped, turned about and disappeared with astonishing speed. He had no fear that they would follow him and devour him.

Now we must explain the circumstances in which a wolf will attack a human being even during the day. It is a most exceptional occurrence as you will see. Wolves, like all the Canidae, sometimes suffer from a contagious disease known as rabies, and if a man happens to meet such a mad wolf he might possibly be bitten. In the same way, a mad fox is liable to attack a person. The mad animal snaps furiously at everything in its way and loses its inborn fear of man. Naturally, any wolf will attack a man if it is brought to bay and there is no other means of escape, but this is rather a counter-attack which is quite a different thing. Animals much smaller than wolves will fight back at a man under such circumstances.

As it thrives and breeds in captivity, the wolf can be seen in almost any modern zoological garden. Like most members of this group, it can reach an age of fifteen years or so, but in the wild state its life is probably shorter.

It has already been said that the **Domestic Dog,** the best known of the Canidae, is a descendant of the wolf. Even in this mechanical age, the dog remains an invaluable servant of man besides being his most favoured companion. Man has bred a great many varieties of dog which differ from each other not only in general appearance but in size and temperament. Compare for example some of the tiny lap-dogs, which one can almost put in one's pocket, with some of the big hunting hounds or police dogs, which are able to hold a man at bay. In this book we cannot discuss the various breeds of dog kept by man and will mention only one, the wild species known as the Dingo.

The **Dingo** is found in Australia. It is of medium size and has a rusty yellow coat. Black or white specimens are seldom seen. Sometimes they have whitish spots on their paws and chest but this is seen mostly in dingoes kept in captivity. Superficially, the dingo closely resembles the sheepdog and has a bushy tail which it usually carries upright in the usual dog manner.

In general habits the dingo resembles the wolf, the hunting unit being a family group or a pack made up of two such groups. Like wolves, they hunt their quarry by chasing it. They hunt kangaroos and smaller animals and can sometimes do immense damage to domestic sheep. Taken as a puppy and kept in captivity the dingo soon becomes tolerant of man, but it becomes snappish and irritable as it grows older.

The Australian dingo has been the cause of many scientific arguments. In the first place zoologists had to ask themselves why it was found in Australia. In the chapter on Marsupials it was said

that the only higher mammals found in Australia were mice and bats — then suddenly a species of wild dog turned up. The natural question arose — was the dingo a native wild animal or merely the descendant of gone-wild domestic dogs? It is now certain that the dingo is descended from domestic dogs which had turned feral and become standardised in type with the passage of time. It is not of course the descendant of dogs brought to Australia by European settlers. This is quite clear from the fact that skeletons of dingoes have been found during the excavation of sites of a much earlier date. The dingo's ancestors were probably brought to Australia by Indians.

The evolution of the present-day dingo can be compared with that of feral pigeons. Although such pigeons are the descendants of domestic pigeons, originally of many colours, they became standardised after several generations and are now difficult to distinguish from the common wild ancestor of all domestic doves — the Rock Dove.

The **Indian Jackal** is a small canine carnivore which inhabits South Eastern Europe, Asia and North Africa. It is about the size of a fox but its nearest relative is the wolf. There are several geographical races of jackal, whose coat colour shows regional variations — some animals are reddish-brown and others yellowish-brown. The jackal's muzzle is broader than the fox's so that its head is cone-shaped. Its brush is shorter than that of the fox and reaches only to the heel joint.

The jackal is a familiar animal in India, Turkey and Iran. The Persians call it Shigal and like to tell stories about its impudence and cunning. It has a reputation very similar to the fox in Western Europe.

Dingo

Dense thickets of reeds on the shores of rivers and lakes are the jackal's preferred habitat. In such places it digs a shallow burrow in which it lies up during the day. The female raises her family in such a burrow. The period of gestation is the same as in the domestic dog, sixty-three days. Litter size numbers from seven to nine young which become sexually mature after two years. Young jackals tame quite easily and soon become attached to their keeper whom they will follow about like a dog. Jackals indeed can be bred with a domestic dog and the young from such a cross are fertile.

Families of jackals will join together

Indian Jackal

to form larger packs, but only in winter. They are omnivorous at all times and will take the remains of prey left by bigger carnivores as well as mice, rats, lizards, birds, fish and even fruit. Snakes, frogs and insects have been found in the stomachs of dead jackals.

Hunting begins at dusk and the jackals are active throughout the night. They are unusually bold and will invade densely populated areas to raid chicken houses or even pantries. At night their howling can be heard over great distances. These howls, although they sound so mournful, are really an expression of pleasure.

In regions inhabited by large carnivores such as tigers, the jackals will join forces with the hyenas as camp followers, ready to clear up whatever prey the big cats might leave. "Playing jackal" is a term commonly used to describe behaviour of this kind in other species.

Here is what Sanderson has to say about jackals:

"One evening I hid near a cow that had just been killed. Before the tiger appeared on the scene I amused myself by watching the jackals.

"Two of them had appeared before sunset and it was very amusing to observe how warily they approached the open space where the dead cow was lying. They were displaying quite unnecessary caution. When they finally mustered enough courage to approach the cow, they immediately swerved away again in a ridiculous fashion. At last they screwed up their courage to the point where they started feeding on the cow. One began tearing at the meat while the other ignored it and remained on guard.

"Suddenly, the watching animal bristled and began to run up and down with its tail between its legs. It obviously thought that the tiger was approaching. But instead of the tiger I saw a third jackal, to whose presence the jealous sentinel objected. The newcomer lay down with apparent indifference to await its turn. The feeding jackal had now been eating for half an hour, during which time the sentinel had not touched the food. Suddenly, both of them leapt away from the carcass and stood as if transfixed, staring in the same direction. Then they began to utter a queer howl, jumping nervously backwards and from side to side. Not for a single moment had their eyes left the spot at which they were staring.

"They began to retreat, snarling. At the same time, I heard the measured pad of a tiger approaching from behind; then its striped head appeared in the moonlight. After a short pause the tiger padded on towards its prey. Then it stopped to look at the jackals. It was now standing alongside me, presenting me with an opportunity I could not resist, so I fired. With a loud roar the wounded beast ran about eighty yards and then sank to the ground. Immediately the moaning of the dying animal filled the silent night."

The **Coyote** is similar to the jackal in general appearance but its muzzle is narrower, more like that of the fox. The coat colour is light greyish-brown, almost fair. Most cowboy stories bring in the coyote in one way or another, but when zealous readers of such stories see a coyote for the first time in a zoo they are usually disappointed, because they realise that this small animal could not perform half the feats attributed to it by the fancy of these writers.

The coyote is found mostly on the open prairies of North America. It resembles

the jackal, not only in size and appearance but also in its way of life. It is, in fact, the American version of the jackal. The animal life of North America has much in common with that of Asia.

The coyote is the Prairie Wolf of North America, a name given to it to distinguish it from the true wolf or timber wolf. An adult coyote will stand about 24 inches tall at the shoulder and weigh up to 40 pounds. The coyote cannot hunt such big prey as the wolf and feeds to a very great extent on rodents, small mammals and insects, but coyotes hunting in a party will chase a deer and harry it until it is exhausted. As a general rule, however, the coyote is a lone hunter. Its senses of smell and vision are highly developed and it is able to run at a speed of up to thirty miles an hour.

When she is ready to give birth to her family, the female coyote excavates a burrow for them, or she may adapt the burrow of some other animal to her needs. Unlike the fox, she pays considerable attention to cleanliness and her den does not become fouled up with the remains of prey.

The **Red Fox** is without doubt the best known member of this family and the commonest of the dog-like beasts of prey. Long known to man for its cunning, it has become the hero of many fables and fairy tales, and the expression "cunning as a fox" is common usage in every European language.

No animal is more adaptable, or resourceful. Its main requirements are cover and food supply and so long as it has these it will live almost anywhere; so it is found on mountains and plains, in forests and woodland, near lakes and ponds, and even in the vicinity of great cities. Foxes

Coyote

actually live within the boundaries of London and Edinburgh, and the same can be said of many European cities. They range over the whole of Europe, Asia and North America and are so familiar by illustration and repute, if not by sight, that it is hardly necessary to describe a fox in detail.

The standard colour of the Common Red Fox is some shade of red, but there are other colour phases. One of these is completely black. Another variant is the Silver Fox, which is found in North America and this type is ranched for its valuable fur. Yet another colour mutant is the Platinum Fox, but these are all common red foxes under their skins.

The fox is not such a close relative of the wolf as the jackal or the coyote. The eyes of foxes have vertical pupils like the eyes of cats. The weight of foxes varies in different habitats according to food supply and season, and probably there are other factors. The weights usually given are 15 pounds for an adult dog fox and 12 pounds for an adult vixen, but many animals weigh less than these weights and many are much heavier.

Mountain foxes are generally bigger and longer legged than lowland ones, and adult mountain foxes weighing 23 and 27 pounds have been recorded in

Scotland. Dog foxes are heavier than vixens.

Foxes moult only once a year, between spring and autumn. In November, the thick winter coat grows in and the fur is prime at the turn of the year. During the rest of the year it is of little value because the long hairs are gradually rubbed off. The summer coat is flat.

A fox den is known as an earth. Quite often this is an enlarged rabbit burrow, but sometimes the fox uses an abandoned badger's sett. Fox and badger sometimes share the same burrow system, occupying different parts of it, and a vixen will even have her cubs there. On its hunting ground, the fox has several lying-up places apart from the main earth and it uses these from time to time. Disturbance, or the threat of danger, will shift the fox from one den to another. In summer, the fox's den is easily found because of the smell which comes from the remains of prey and the clouds of blowflies about the entrance. The badger, on the contrary, keeps the surroundings of its sett and the burrow itself always perfectly clean.

The earth or den may be in shrubberies, reed beds, sea cliffs, gorse brakes, old quarries, gravel pits, mountain cairns, or among the wildest screes. In mountain areas, cairns and holes in rocks are commonly used. In the Scottish Highlands, Wales and the English Lake District, a fox's den can become a veritable fortress of great rocks, often as big as a house with holes reaching a depth of 40 feet. Cairns of this kind can be half a mile long, so that the fox is safe from almost all its enemies and is difficult to locate. Many terriers are necessary before a fox can be bolted from such a stronghold.

The fox marks his territory with urine and droppings and leaves his marks along his favourite routes and between one lying-up place and another. If disturbed or frightened in one place, he will change his quarters and his route. No animal is less hidebound by habit than the fox.

In less populated areas, foxes can often be seen on foot by day, and even hunting in daylight. They like the sunshine and can sometimes be seen fast asleep sunning themselves in a quiet sheltered spot. In good weather, some of them will lie out during the whole of the day so long as they are not being disturbed. Mountain vixens will sometimes take their cubs to some sheltered, open-air spot among rocks or heather and settle the family there for a period.

The mating period of foxes is from January to early March. During this period several dog foxes will follow one vixen and fight over her, sometimes savagely but without doing very much damage to each other. Once a pair has mated they stay together and may do so for several years.

Some time before her cubs are due to be born, the vixen prepares her nursery. Frequently, she enlarges a disused rabbit burrow, perhaps because it affords easy digging; but breeding earths can be in a great variety of places and mountain foxes habitually use cairns and holes in rocks. In such areas, vixens will be found in the same places year after year. Unlike the badger, the vixen does not carry in bedding of any kind and, apart from plucking some of the soft fur from her abdomen, makes no sort of nest for her cubs. The gestation period is fifty-one, or fifty-two days and her litter may number anything from three to eight, blind young. The fur of the cubs is soft and may be silvery grey, or mousy-blue, ac-

cording to the area. The cubs open their eyes after twelve to fifteen days.

There is only one litter a year and where a large litter of nine cubs or more is found, it is usually because two vixens have whelped together.

Fox cubs begin to appear at the den mouth when they are approaching four weeks of age and are strong and playful by the time they are six weeks old. Their play can be rough and they spend much of their time in mock fights, grapples and chases. They are weaned when they are about eight weeks old, but long before then are eating prey brought to them by the parent foxes. In the early stages of weaning the vixen will vomit predigested food for her cubs. She will move them to a safer place at the first hint of danger and in any case will usually make one move to fresh quarters. The family begins to break up when the cubs have reached the age of three months. They reach adult size at the age of six months and breed in their first year.

The vixen is a very attentive and careful mother, but she is greatly helped by the dog fox in bringing up the family. He carries the food to her while she is nursing the cubs and helps her to provide food for them when they are weaned. After weaning, their appetites grow and both parents are kept busy supplying them with food. This is the time when foxes do most damage to man's interests because they are hard pressed to meet the increasing demands of a growing family. It is at this time that they are most likely to raid poultry houses, or pheasant-rearing fields. In mountain areas they may take lambs. But foxes are quite incapable of killing a deer, although it is often stated that they can do so.

Gamekeepers look upon the fox as a wanton killer and destroy it at every opportunity. They shoot, trap, and poison nursing vixens, with the result that the cubs die of starvation. Another method is to seal the entrance to the den with rocks so that the entire family dies of starvation.

In some parts of Europe, dachshunds and terriers are used to kill the vixen and her cubs in the den. In the Scottish Highlands, terriers are put into the den to bolt the vixen and kill the cubs; the vixen being shot as she breaks out. Dens in great cairns are more difficult and many terriers are lost in them. Some keepers will prick a fox with gunshot at long range, knowing perfectly well that the animal will die later of blood poisoning. Much killing of foxes is inhumane and it is by no means certain that it is all necessary.

There has always been much argument about what foxes actually eat. Characteristically, gamekeepers think of game and act as though foxes fed entirely on pheasants, hares and rabbits. A great deal of work has recently been done on this subject by the examination of stomachs and the analysis of droppings. In Britain much of this work has been done by Lockie, while in Europe, the Bulgarian zoologist, Dr Neno Atanassov, examined 201 stomachs and a great number of droppings. He found that the fox's main food consisted of small rodents. These were found in 194 stomachs and made up half the food consumed. Other small mammals were found in 30 per cent. of the stomachs. Hare remains were found only in 22 stomachs. Other items were squirrels, susliks, domestic cats, small birds, insects, a variety of vegetable matter and, exceptionally, poultry. After having divided all this food into two groups under the headings, harmful and useful animals,

Atanassov reached the conclusion that the fox ate 57 per cent. harmful animals, 27 per cent. useful animals and 16 per cent. vegetable food.

In the Highlands of Scotland, field voles are a favourite prey item and Lockie has reckoned that a fox will eat one thousand of these animals in the winter months when each vole is eating twenty-three pounds of grass.

Besides voles and mice, foxes eat slugs, snails, frogs, snakes, lizards and insects. It can kill deer calves but not adult deer. It will clean up the wounded and dying left by careless shooting men. During the winter months it can survive on carrion such as dead deer and sheep. It kills rats at all times and rabbits at any time. In the autumn it takes a great deal of vegetable food such as blackberries, raspberries and blaeberries, and these can make up as much as 20 per cent. of the food in its stomach.

In spite of the fact that the fox does some damage to small game, there is no justification for condemning it in the way gamekeepers do. As we have seen, it does much useful work. Some European zoologists even consider that the facts justify a close season for foxes during the period when they have cubs, and consider that killing should be done in winter, when, in any case, their fur is at its best.

Voles and mice are probably the fox's commonest prey and any sound resembling a mouse or vole squeak will attract their attention. European hunters, familiar with this weakness of the fox, sometimes imitate the squeaking of mice to lure the animal within shooting distance. One zoologist reports that he has, many times, called a fox from a considerable distance in this way. The sound is produced by inhaling through closed lips pressed against the back of the hand. This zoologist has lured foxes to within twenty yards.

In the same way, a fox can be called in by imitating the bleating of a captured hare, and in Europe special decoy whistles are sold for this purpose.

Nature prevents foxes from increasing beyond their food supply and many perish from certain diseases, notably red mange, scab, and, in Europe, rabies. In this way, their numbers are regulated. In addition, the fox is often the prey of the wolf in areas where wolves are common.

Despite all man's efforts however (snaring, hunting, shooting, trapping, poisoning and digging), the fox survives almost everywhere and is in no danger of being exterminated. It is time to revise our attitude to the fox and cease judging it by its worst faults. Its predation on voles alone outweighs all the other damage it does and it would be a tragedy if we ever managed to exterminate the fox, which is after all one of the most beautiful animals of the countryside.

The **Corsac** is a typical inhabitant of steppes and semi-deserts of Asia and Europe. In Europe it occupies only a fringe reaching to about Rostov. It is rarely encountered in the South-western Ukraine and its main habitat is undoubtedly Asia.

The corsac is a small fox about $19^1/_2$ or $23^1/_2$ inches in length, plus its tail of $11^3/_4$ inches. It closely resembles the common red fox but has relatively longer legs. Its colour is mainly yellowish-grey, which matches its surroundings. In years when rodents increase greatly in numbers, the corsac becomes more numerous and can then be found in wooded areas and in foothills.

Although the corsac is a shy, alert, largely nocturnal animal, its numbers have been declining in recent years in the Soviet Union, and this is almost certainly due to the increase in the number of hunters and the perfection of modern fire-arms.

Corsacs breed once a year, the usual litter size being from two to four cubs, which remain with the vixen for a long time after they have left the nursery burrow.

The **Arctic Fox** is a relative of the Red Fox, but inhabits the polar regions and tundras of Northern Asia and North America, where, with the polar bear, it makes up the two most northerly species of land mammals. It is easily recognised by its very short rounded ears which are almost hidden in its dense fur.

This fox exists in two distinct colour phases, one with a light brown summer coat which changes to white in winter, and the other whose fur is greyish-blue throughout the year. The second is the well-known **Blue Fox,** which is one of the rarest and most valuable fur-bearers. Commerce statistics give an indication of the relative status of the two species in the wild. North American hunters provide for the market 14,000 to 18,000 white foxes a year, but only 3,000 to 4,000 blue foxes. To prevent damage to their fur, the foxes are caught in special traps. Arctic foxes are also bred on fox farms, but the best furs always come from animals caught wild.

In the wild state, the Arctic fox lives in small bands and will feed on anything that is available in the way of food. Since some of them live in the regions of eternal ice their diet is not very varied, and they often take what is left over by the polar bear as well as stranded fish and other carcasses. In the tundra they also feed on small rodents and fruits and will take the eggs and young of waterfowl.

The mating season of the polar fox begins in March. The gestation period is fifty-two days and litter size varies from four to eight young. The cubs are born in a warmly lined den. In areas where the foxes are not accustomed to man, they have no fear of him and will visit tents quite openly to steal food.

Red Fox, Silver Fox, Arctic Fox, Corsac

Another member of the fox family is the **Fennec** which stands about $7^3/_4$ inches tall at the shoulder and measures $23^1/_2$ inches in length, including its tail of nearly 8 inches. This species is one of the most attractive of all the canine carnivores and has huge cone-like ears and large, dark eyes. Its fur is pale sandy-yellow in colour, which matches its background of desert and semi-desert. The fennec inhabits the desert areas of North Africa.

The large, dark eyes of this species indicate that it is a nocturnal animal. Sometime after sunset, it leaves its burrow to hunt. Its senses of smell and hearing are acute and it can hear even the slightest rustle, including the creeping of tiny insects. The fennec hunts mostly small prey like mice and jerboas, but it will take sleeping birds and steal eggs from nests. Insects are a great delicacy. The fennec cannot deal with bigger prey because its teeth, which are as sharp as needles, are too tiny.

The fennec's large ears do more than gather in the slightest noise; they radiate heat from the animal's body. Because they provide an increase in the body size, they help to maintain its temperature at an even level during periods of great heat. Other species living in hot climates often have parts of the body similarly enlarged to radiate surplus heat. On the other hand, animals living in a cold climate show a reduction of body surface; these animals must economise their body heat and so are protected against unnecessary expenditure of it. An example of this is provided by the Arctic fox, whose ears are so well hidden by the thick fur that they are almost invisible. The gestation period in the fennec is fifty-one days. Sometime before the birth of her cubs the female digs a deep burrow, which she lines with hair, feathers, and palm leaves. In March she gives birth to her litter of three or four young, which remain blind for the first ten days of their lives.

Natives catch the fennec by means of a noose placed around the entrance of its burrow and it is an interesting fact that the fennec never tries to bite the noose as the red fox would do. In any case, it is unlikely that their fine teeth would make any impression on it.

Because of its beauty, the fennec is an attraction in any zoo, but old fennecs are untamable in captivity. They crouch down at the approach of a man and try to bite. Young animals, on the other hand, are easily tamed, soon become attached to their master, and follow him about like a dog.

Dr. Jiri Baum has an interesting chapter on fennecs in his book — *Through Steppes and Jungle.*

"For a long time I kept a tame fennec whom I called Felix. When I got it, it was still a puppy and it seemed to be made entirely of enormous ears and eyes. The sand-hills of the Sahara had been its homeland.

"Daytime for the fennec is the time of rest, but at night it leaves its burrow to hunt its prey. A rare delicacy are the jerboas, which, like the kangaroo, take very long jumps on their hind feet, but this was not for Felix. He had become my travelling companion and had to travel far to cold northern regions.

"Together, we journeyed through the wasteland at Meknes and through the wooded hills of Tebessa, where every stone tells its story of the past glory of the Roman Empire. During these travels we became good friends. Felix accompanied me on my walks like a faithful little dog. When I collected beetles, he

collected them too, but he was interested only in eating them.

"One day, we left Africa and sailed for Europe. Felix soon became accustomed to travelling and did not cause any difficulties. The last night of our journey we spent on a train and Felix slept curled up on my travelling bag. With our arrival in Prague our journey came to an end, and in a short time Felix had adapted himself to the new way of life.

"He loved visitors. When strangers arrived he sometimes retreated into hiding, but he was always ready to welcome friends with penetrating shrieks and a friendly wag of his tail. He loved to be patted and his greatest delight was when somebody scratched his back.

"While he was still young he loved to be cuddled. Later, he did not like to be picked up, but he would jump on to my lap while I was sitting quietly. Small children could do with him as they liked.

"He soon changed his nocturnal habits and become very lively during the day. He liked to sleep in my bed and liked when I played with him. He liked toys such as small bones and balls and when I threw one of these for him he would go and look for it just like a dog.

"We used to go out for long walks together and Felix would follow me in a well behaved manner until something attracted his attention. Then he would sit down and no amount of persuasion would move him. He simply would not move until he had inspected whatever had attracted his attention. He liked dogs and wanted to make friends and play with every one he met. Some dogs appeared to be frightened of him, but even the biggest St. Bernards were unable to resist him when he began to tease them.

"Autumn arrived, the days became

Fennec

shorter and the sun a rare guest. Felix now discovered a new source of warmth — the stove — and spent most of the day lying beside it. After warming his back beside the stove, he would roll over with his legs in the air to warm his stomach.

"He had a most varied menu. He ate everything I did but preferred meat and fruit. On his walks he paid a lot of attention to insects and was eager to reach the unreachable birds. Bird song always made a deep impression on him, probably because he thought of the birds as dainty titbits. He was indeed so fond of birds that he would even attack stuffed ones. When he became adult, his fur changed to a beautiful yellow colour. His voice changed too. Now he knew how to snarl and he could bark in a ridiculously high-pitched voice and he became even tamer.

"The time passed and it appeared that Felix had adapted himself completely to his new life, but for a native of the Sahara our northern climate was too cold. He began to languish. For whole days he would not move from the warm stove and then, one day, I found him dead."

When carefully looked after, the fennec will live in captivity up to nine years.

The **Racoon-like Dog** is quite different in appearance from the other members of this family. As its name indicates, it is more like a raccoon than a dog in its colour and body shape. It is about the size of a raccoon, with a strong, rounded body and short legs. Its long, shaggy fur is almost like a badger's and it has a short tail covered with long hair. This species is hunted for its handsome fur.

The racoon-like dog lives in the Far East, Manchuria, China, Korea, in the region of the River Amur, and in Japan. Recently, it has been successfully introduced to European Russia, mainly for its valuable fur. It has been introduced to other areas, but the drawbacks to such introductions soon became apparent. The racoon-like dog began to increase at an unexpected rate, and in some of the Russian reserves to which it had been introduced, the balance of nature was upset and many native animals began to decline in numbers. The Russians made a short film depicting the racoon-like dog in a less favourable light than during the period of its introduction.

The introduction of this species seems to have been ill-judged, and something of a disaster, as is so often the case with imported species. It was soon found that the animal destroyed not only young birds but also nests, and could be as destructive as a crow. It is highly probable that the racoon-like dog will become a problem animal in Europe during the next few years.

Racoon-like Dog

Following their successful introduction and their subsequent increase in numbers, racoon-like dogs began to colonise new areas westwards, and they have now been reported from Finland, Poland, Rumania, Hungary and even the Federal German Republic. Although reports of its occurrence in Eastern Slovakia have not been confirmed, they may well be true. In every area colonised by this species, man has had to wage ruthless war against it. Its spread provides one more example of the way an exotic species can take over in a new and favourable environment.

The racoon-like dog has retained many of the evolutionary characters found in the ancestors of the carnivores. It has forty-four teeth, the same number as in the extinct beasts of prey and its molars have broad crowns, indicating that the species is omnivorous.

Swampy forests and bushy river banks are the favourite habitat of the racoon-like dog and each pair shares a burrow. The mating season is in March and April. After a period of sixty to sixty-four days' gestation, the female gives birth to a family of six or eight cubs, but up to fifteen have been reported. The cubs are blind for fifteen days. The male helps to rear the family by carrying food to his mate and her cubs.

Racoon-like dogs feed mainly on frogs, dead fish, slugs and insects, but they also take small birds, bird's eggs and small mammals, and in the autumn feed to a great extent on berries. With the coming of winter, they retire into their burrows and fall into a torpor resembling true hibernation. This is the only canine car-

nivore in which this winter lethargy has been noted.

The **Maned Wolf** has the longest legs of the family and reminds one of a greyhound, except for its head which is more fox-like than dog-like. It is cinnamon-brown in colour; its long ears stand erect. Despite its size, it has a small chest and, consequently, a small lung and heart cavity, so it is not a good long-distance runner. Its long legs are not so much designed for long-distance running as for easy movement among the tall grasses of the savannas of Central Brazil and the Grand Chaco which are the animal's home. The maned wolf trots around without haste, stopping every now and again as though on guard to listen with its long, sensitive ears. In this manner, it hunts a variety of rodents, lizards and other small animals. It is said to feed also on the fruits of certain plants.

The last species in this group which we shall deal with is the **Cape Hunting Dog.** This species has a short muzzle and long, slim legs and is one of the biggest members of the dog family, standing from $27^1/_2$ to $29^1/_2$ inches high at the shoulder and measuring almost 5 feet in length. It weighs from 66 to 77 pounds. Cape Hunting Dogs show a great variation in colour and it is almost impossible to find two animals exactly alike. The muzzle and the large, cone-shaped ears are always black, but the coat varies in the extent of the pattern and blotching of three colours — black, white and ochre-yellow.

The Cape hunting dog inhabits tropical Africa. It lives in small packs which are the terror of all living things as African travellers have often testified. It is indeed

Maned Wolf

the most feared of African beasts, being a greater enemy of other mammals than the lion or the leopard. As soon as Cape hunting dogs appear on the plain, the herds of hoofed mammals become terror stricken and flee in blind panic. This is entirely different from their reactions to the presence of a lion.

Hilzheimer has given a graphic description of Cape hunting dogs in action.

Cape Hunting Dog

"It is a magnificent spectacle to watch these beautiful and skilful animals hunting. A giant sable antelope, well able to defend itself, has just been alerted by them. Knowing the nature of its pursuers, it runs across the plain as fast as it can with the pack following in full cry, barking and howling shrilly. The medley of sounds is like the ringing of bells. The hunt goes on and on and the antelope forgets all other perils. It pays not the slightest attention to man, whom it otherwise carefully avoids, and may even pass close to a person with the pack of dogs at its heels. The dogs run tirelessly in disciplined order. If the leader tires, it is relieved by an animal from the rear which is relatively fresher.

"Finally, the sable antelope is tired out and the chase comes to an end. It turns to face its pursuers and within a few minutes is borne to the ground and mauled. During this final struggle, some of the hunting dogs are injured. Sometimes the hunted animal will gather its strength and break away so that a new chase begins. Finally the hunting dogs run it down, drag it to the ground and begin to tear out chunks of meat and intestines."

Cape hunting dogs are often wasteful feeders, devouring only a small part of the carcass and leaving the remainder. This can cause great losses among wild game. As a result, all Africans hate the Cape hunting dog and kill it whenever they can.

Fortunately, Cape hunting dogs are never numerous and one pack will hunt over an area of a few hundred square miles. It is an interesting fact that the dogs do not fear man at all, so that when a hunter encounters a pack he is usually able to kill every animal in it. The dogs, instead of running away, look on quietly while one after the other is shot down.

This species is highly popular in zoos where it thrives and breeds. The period of gestation is sixty-three days and the usual litter size is from two to six puppies. The puppies quickly become attached to man, fawning on him, wagging their tails and barking, but they alway remain unreliable and snappish, even when treated kindly.

STOATS, WEASELS, MARTENS, ETC.
Family MUSTELIDAE

This is a numerous family of small, or medium-sized, beasts of prey, having long, slender bodies and short legs, and representatives can be found all over the world with the exception of Australia and the island of Madagascar.

It would be difficult to find any characteristic common to the whole family, because the members differ widely from each other, not only in appearance but also in their way of life. They are all alert and agile and feed mostly on living animals. Many of them are valuable fur-bearers and some are ranched for their furs. The family is divided into three sub-families — the weasels, badgers and otters.

Weasels are, generally speaking, the smallest beasts of prey, even although some of the larger carnivores belong to this subfamily.

The **Pine-marten,** or **Sweet-marten,** is about the size of a domestic cat, but its body is more slender. Its fur is dense, smooth, and brown in colour; darkest colouring being on the legs and the bushy tail, which are blackish-brown. The cushioned soles of the marten's feet are furred as well, which is very important in climbing as the hair on the soles prevents the animal from slipping when it is running along an ice-covered branch. Its large ears are pale along the edge, the nose is black. There is a creamy yellow or orange spot on the throat which is a distinguishing feature. The pine-marten is $31^1/_2$ inches in length, including its tail, and weighs from 2 to 3 pounds.

This species inhabits forest regions in Europe and Asia and is active early and late in the day. During the daylight it sleeps either in a hollow tree or in a deserted bird's nest, or a squirrel's drey. Shortly after sunset it comes out to hunt. It is an excellent climber and jumper and moves in the tree tops with the agility of a squirrel. It can leap a distance of four yards from branch to branch, or from one tree to another. On the ground, it moves in short jumps.

Like the fox, the pine-marten has a number of reserve lairs apart from the main one. It marks the boundaries of its territory with a secretion from the scent glands under its tail. These scent markers are found, along with the animal's droppings, in trees, on forest paths, and on stones and other prominent places inside the territory. Its scent is not so unpleasant as that of the polecat, which is often called the foul-marten.

The pine-marten is guided when hunting mainly by its senses of sight and hearing, for although its sense of smell is good it is not nearly so highly developed as in the dog family. One result of this is that it is easily caught in steel traps, a failing it shares with most of the weasels. Its main food consists of small mammals and birds and it is not true that it attacks deer, although this is frequently asserted in hunting literature. On the contrary, it has been clearly shown that the marten is afraid of bigger animals. A marten in a poultry house can work great execution, but recent research suggests that it kills excess birds more out of fear than out of blood-thirstiness. The pine-marten catches its prey by leaping on to its back and biting deeply into its neck behind the ear, but it does not suck blood.

Where squirrels are numerous they form a main prey item. The pine-marten is in fact a specialist predator on squirrels, killing them in their dreys or in the highest branches where it can match and outmatch their agility. Once a marten begins to chase a squirrel, the squirrel seldom escapes. By its predation on squirrels, the marten performs a useful function so far as man in concerned because squirrels can cause great damage to forests by biting off the shoots of pine trees. Squirrels also pillage birds' nests.

Regarding the pine-marten's alleged blood-thirstiness (this is a word frequently used about weasels in general by ill-informed people), one European zoologist of wide experience has written:

"If I care to express an opinion regarding the blood-thirstiness of pine-martens, which has often been mentioned in literature, I would prefer to do so with an example. In the granary of a certain state farm, I caught twenty sparrows in an Italian cage trap and turned them loose in the cage of a pine-marten that had already eaten several pieces of poultry and rabbit as well as mice and sparrows.

The marten lived in an enclosure measuring 3×4×4 yards. The time was about 2 p.m. The pine-marten had eaten for the last time on the evening of the previous day. It goes without saying that I expected all these sparrows to be devoured by the pine-marten but I was disappointed. It caught the nearest one first, crushed it and let it die. Then it caught another one and started playing with it like a cat with a mouse. Of course, the sparrow did not last long with this treatment. After wetting it, the pine-marten went to hide it and while it was on its way a third sparrow almost flew into its mouth. The pine-marten let go the second one and crushed the third one. During this meal, I offered the marten a jam bun, which it snatched eagerly, letting all the sparrows go. In fact while eating this delicacy it snarled at any sparrow that came near. Then it wetted the three dead sparrows and returned to its cabin. After a while, it got up, hid the dead sparrows in a safe hiding place and went back to sleep. The following day it ate about three more sparrows, but I had to let the rest of them loose because they were too big a ration for it."

Apart from small mammals and birds, the pine-marten also eats a variety of fruits, bulbs and insects, and during the summer its droppings contain a high proportion of stones.

The paws of Pine-marten (left) and Beech-marten (right)

In Scotland, Lockie has studied the food of the pine-marten in the Highlands. He found that during most of the year small rodents and small birds made up the bulk of its prey, with the short-tailed vole the most common mammal item. Bird prey was mainly tits, wrens, tree creepers; young hares and rabbits were also killed as available. Beetles, caterpillars, cocoons, carrion, fish, wasp grubs, and berries are also eaten. Favourite berries are rowans and whortle-berries. Captive martens require four ounces, or more, of prepared food each day, but wild animals would almost certainly require more than this because they are more active and eat much that is indigestible, including the fur, bones and teeth of small mammals.

The mating season of the pine-marten is in July and early August and at this time they are most vocal. They snuffle and snarl and bark. They will toss twigs and shoots down from the trees and will roll tins and other objects about if they happen to get into the attic of a forester's house. So it would appear that they like making a noise at this time.

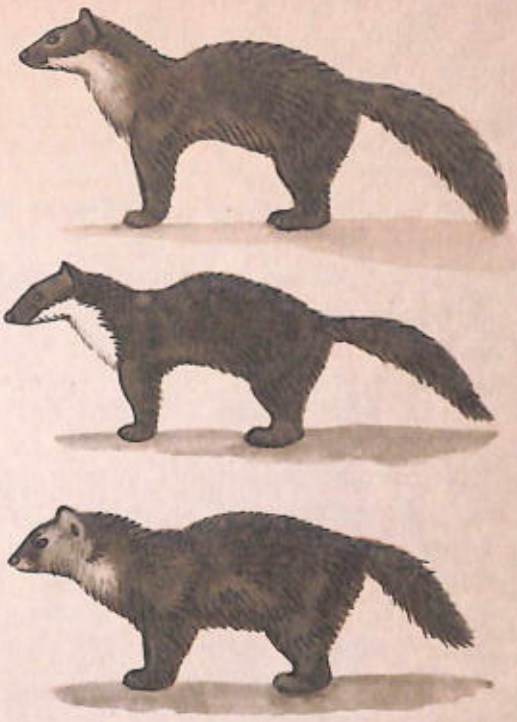
Like the stoat, the marten breeds only once a year. Their breeding cycles are similar and there is delayed implantation. This means that development of the young animals is arrested when the fertilised eggs reach the blastocyst stage. The blastocysts remain free in the uterus until the month of January when they become implanted in the uterine wall and the development of the young continues. Why this should take place in the pine-marten and certain other animals, inside and outside the weasel family, is not known.

The young martens, numbering from two to five in a litter, are born in late

March and during April. They are small and blind, weighing only about one ounce. Their eyes open after thirty-four days and they begin to appear at the den mouth at the age of eight weeks. They become independent of their parents somewhere around the age of five months. All the young animals reach their adult weight during their first summer, but do not breed until their second.

The pine-marten is an attentive mother and will defend her young with great courage against any threat to their safety. A captive female was reported killing a much bigger male that had approached her young. The marten quickly becomes tame if taken when very young and artificially reared. Tame animals will climb all over the owner and accompany him like a dog. They are clean in a house and always leave their droppings in the same place. They are extremely playful and when not sleeping would play all the time with their master. A drawback about them is that they are at their liveliest during the night. If well cared for a captive pine-marten will live for eight to ten years.

In Great Britain, the pine-marten had been almost exterminated by the beginning of the twentieth century, and the few surviving animals were confined to the North-west Highlands of Scotland, with fewer still in Ireland, Wales and the English Lake District. In the twentieth century, its revival began because the new forests of the Forestry Commission provided it with cover and a suitable habitat. This has been particularly true of the North of Scotland and pine-martens there are continually colonising new areas. To-day, the marten in Britain is found mainly in coniferous forest but also in birch-scrub, rocky gorges, open hillsides and crags with plenty of vegetation.



Comparison of sizes and shapes: Pine-marten (above), Beech-marten (middle) and Sable (below)

Although a forest animal, inherently it is an adaptable species.

Marten dens in Britain are most often in rock cairns, crags or in holes in trees. So far, they have not used any nest boxes, but have been recorded in the old nests of buzzard and magpie. They like to hide in the peat layer on top of a large boulder.

The **Beech-marten** is a close relative of the pine-marten, but is smaller in size and slightly different in colour. The throat patch is white and hardly ever yellow as in the case of the pine-marten. It is not rounded at the bottom but forks down towards the forelegs. The cushions of the paws are covered with hair. Its ears are smaller and the fur greyish-brown. The beech-marten's range is much the

same as the pine-marten's but it does not occur in the British Isles.

Originally, the beech-marten was an inhabitant of rocky areas and still is in sparsely populated regions. In time, however, it became used to human dwellings and in Europe at least is a common inhabitant of buildings, even in big cities. It prefers to settle in attics or old barns. Human dwellings probably remind it of its original rocky environment, and, in any case, food is easy to find there. People often blame the beech-marten for raiding dovecots and poultry houses, but it visits such places mainly to hunt rats and stomach analysis shows that 80 per cent. of its food consists of these rodents. Otherwise, in its breeding and general habits, it resembles the pine-marten. Fric compares them as follows.

"If I were to sum up the qualities of martens as I know them from observation of wild and captive animals, I would say that they are not at all particular as to the kind of food they eat. They are not all blood-thirsty and are very easily tamed. Tame animals like nothing better than being caressed. I caught a strong beech-marten in the garden and brought a tame pine-marten beside it. The animals bristled at the sight of each other. The pine-marten climbed up into a high tree and did not come down again for an hour after I had removed the beech-marten. Soon, however, they were both playing with a kitten and they played in the same way with a puppy."

The **Sable** is closely related to the martens. This inhabitant of the Siberian forests was saved at the last moment from total extinction. Its fur is finer than that of the pine-marten and uncontrolled hunting almost exterminated it. The highest prices are paid for pelts which have a silky bluish under-fur. Before the first World War, 70,000 sables were killed each year for their furs, and in Siberia people used sable skins rather than money as a means of exchange. Czarist officials gladly accepted such payment in kind because they could make such great profits later from the skins.

The sable was saved from extermination by the Soviet government which established reservations for the few animals left. Shooting was prohibited but a few animals bred in captivity and this made possible the establishment of breeding farms. But even this has not greatly increased the number of sables.

The sable can be readily distinguished from the marten by its more cylindrical head and its orange throat and cheeks. Its ears are more pointed than the pine marten's.

The **Weasel** is probably the best known of all the Mustelids. It inhabits Europe, North Africa and most of Asia and is recognised at once by its small size, the snake-like slimness of its body and its nimble movements. Its fur is rich brown above and white on the underparts. The line of demarcation between the colour zones is lobed with brown. Weasels living in the far north of Europe and Asia regularly turn white in winter, but this change is rare in more southerly latitudes.

The male weasel measures from $8^1/_4$ to 9 inches in length. The female is considerably smaller and measures from $6^1/_4$ to 7 inches. The tail is short, about $1^1/_4$ to $2^1/_4$ inches long and the same colour as the upper fur.

The disproportion in size between the sexes is most notable in this species, females ranging up to three ounces and males

up to six or, in exceptional cases, even up to eight or nine ounces. Feeding has a great influence on weight.

The weasel can thrive in a wide variety of habitats; therefore, it can be seen in fields and meadows, on slopes, in woodland and close to human habitations. It is frequently seen about farms, where it hunts mice and rats. It avoids deep forest and swamps.

Because of its constant predation on mice and voles, the weasel is a highly important animal in maintaining nature's balance and is a most useful species to man, although he does not always appreciate its services. It hunts by day as well as by night and does not mind being watched by a human observer so long as he does not directly intrude. With its slender body, the weasel can travel through vole creeps and down mouse-holes with the greatest of ease. It kills by biting its prey through the nape of the neck, but it is not true that it sucks the blood of its victim. Exceptionally, a weasel will attack prey far outside its normal range, such as leverets, partridges or young pheasants. Its main prey in most places consists of voles and mice and it is a great mistake to destroy weasels as a routine.

In the British Isles, the weasel is found all over the mainland, but is absent from Ireland and all the islands except Skye and Rassay. There is a widely held belief that in Britain there are two species of weasel — the common weasel and the so-called mouse weasel, or miniver. In fact, there is only one species and the mistake arises because of the great difference in size between the male and female weasel. The females are so small by comparison that they are often mistaken for a different species.

There is no delayed implantation in the weasel as there is in the stoat. Females are in breeding condition from March to August and two litters are produced each year in England; in Scotland, the season is later and one litter is almost the rule. The number of young in a litter varies from four to eleven, but it is more likely to be six and even fewer in young animals breeding for the first time.

In its turn the weasel has many enemies, including eagles, hawks, owls, foxes and even stoats, but man is by far the most important predator and can exterminate a local population by persistent trapping.

A female weasel is bold and will face death in defence of her young. She will even face and shriek at a man but will not bite if not molested. She will face a dog or a cat in their defence and will continue biting and shrieking even when her back is being broken. It is, however, quite untrue that a weasel will make an unprovoked attack upon a human being.

Young weasels, like the young of most animals, play a great deal and their movements are almost too swift for the human eye to follow. They become less playful as they grow older, but one thing they never lose is their curiosity. A weasel that seeks refuge in a wall or drain at the appearance of a man, will peep out shortly afterwards to see if he has gone. Because of this habit it is an easy target for a man with a gun, and all a gamekeeper has to do is stand by until the animal comes out for a second look at him. It is incredible that such a small animal is able to kill a powerful rat two or three times its own weight. Equally incredibly, it can haul such a burden for some yards and drag it to cover.

Stephen has described how a small female weasel killed three large rats in

under fifteen minutes and dragged the bodies to a heap of drain pipes. The rats were four or five times her weight. All three were killed in an old wall where they had little room to manoeuvre and squealed loudly in the weasel's grip.

It is not an uncommon sight to see a weasel crossing the road with a mouse or vole in its jaws. Less commonly, one can be observed struggling with a rat in a farmyard; but in the open the rat has much more room to manoeuvre and a large, powerful one may kill a small weasel. There is a record of one weasel killing nineteen rats in a potato shed in one night.

During a year of vole plague, weasels will move into young forests to prey entirely on voles. Once the vole numbers crash, the weasel, like other predators, begins to move out until only a few are left, but the weasel can stay longer than the others because it is small enough to invade the vole's burrows and kill them there.

Weasels will breed readily in captivity if given some room and properly cared for. They ask little more than a warm nest and a regular supply of mice. The young animals tame readily if handled from the time they are very small but tend to wander away if allowed their freedom out of doors. A nursing female, on the other hand, will return to the nest where she has her kits. The cleanliness of the weasel can easily be seen in captive animals. They do not foul their nest and always deposit their droppings and their urine in the same place so that their cage is easily kept clean.

The **Least Weasel,** which is found in Europe on the same ground as the common weasel, prefers to inhabit higher regions. The male in this species is from $6^1/_2$ to $7^1/_2$ inches and female 5 to $6^1/_2$ inches. The tail is from $1^1/_4$ to $1^3/_4$ inches in length. In the least weasel, the line of demarcation between the brown upper parts and the white under parts is straight and clean cut. Some of these small weasels turn white in winter and, like the common weasel, can always be distinguished from the larger stoat because of their short tail and the absence of a black tip.

The least weasel occurs in four subspecies which range over Canada down to the Northern United States. It has been suggested by Hall that this species extends westwards over the U.S.S.R. to Central Europe.

The **Stoat** is larger than the weasel and can be surely distinguished from it by its long, bushy tail with the black tip. Even when the stoat changes to white in winter, as it does in all the northerly parts of its range, the bushy tip of the tail remains black. In its winter dress, the stoat becomes the ermine of commerce. The summer coat resembles the weasel's but again the long, bushy, black-tipped tail is a sure guide. The stoat measures $8^1/_2$ to $11^1/_2$ inches, plus its tail of $4^1/_4$ to $4^3/_4$ inches. Female stoats are smaller than males by about one-third and this size is reflected in body weight.

The stoat inhabits almost the whole of Northern Europe, Asia, including Northern Mongolia and China, Japan and North America. Related species inhabit North Africa, the Near East and Asia Minor. The stoat mates in June and July and there is delayed implantation lasting until the following March when real development begins. The young stoats are born in April and May. Animals which were unmated in July can mate early in

the following year and still produce a family on time that year, but there is only one litter in a season. Litter size varies from five to seven young which grow rapidly, the young females being in breeding condition by the month of July.

Stoats are accomplished climbers as the following incident described by Fric shows.

"At 5 o'clock in the morning I saw a stoat crossing the road dragging a prey with great difficulty. It disappeared with its prey among a heap of stones by the roadside. The stoat was being pursued by starlings which were attacking vigorously, some of them flying right up to it; so I thought that the stoat had kidnapped a young starling. Starlings were flying out of tree hollows in nearby orchards and out of the nesting box which I had hung up for them. In the afternoon, I again noticed a great commotion among the starlings and finches near the spot where I had seen the stoat in the morning. The shrill whistling of the birds was concentrated around an old pear tree where two starlings were nesting. You can imagine my surprise, when, after a little while, I saw the stoat creeping out of a hole in the pear tree, at least six yards above the ground. It came out rear end first, holding in its mouth a young starling which was almost ready to fly. The starling's head was drooping and it had obviously been killed in the nest. The stoat came down the rough trunk of the pear tree head first, holding the prey securely in its jaws."

In Britain, stoats have been observed raiding the nest of woodpigeons high above ground. In addition to climbing trees the stoat can climb the vertical face of a roughcast wall, or wire netting, or trellising. Nevertheless, it kills most of its prey on the ground. It kills all the species preyed upon by the weasel but can take much larger animals. Before myxomatosis killed off most of the rabbits it was a considerable predator on this species and suffered greatly when the rabbits disappeared. It is an accomplished rat killer and will also take water voles. It will kill any bird it can catch and hold. Like the weasel, it is of very great value to man despite its occasional depredations in poultry houses or in pheasant rearing fields.

Young stoats are extremely playful and do not lose the habit even when they grow up. Male and female will play together as adults, crooning and chortling as they carry out their mock chases in hedge bottoms, over windfalls, and in the branches of trees. It almost appears that the stoat indulges in play when not hunt-

Stoat in winter, Stoat in summer and Weasel

ing or sleeping. A single stoat can amuse itself for minutes at a time by swinging on fence wires, climbing fence posts, spinning like a top, chasing its tail or hanging upside down by its hind feet. It will leap, dart, cartwheel, and somersault, and likes bouncing, time after time, with its four feet from a wall.

When a stoat hunts a rabbit it follows that rabbit, ignoring all others. Other rabbits seem to know this and pay no attention to the stoat. The hunted rabbit at some point usually gives up and crouches in the grass, whereupon the stoat comes up with a final rush and bites it in the neck. It will drag its victim into cover and eat its fill, but it does not suck blood.

A stoat will sometimes attack a hare, but a strong hare will not give up readily and sometimes succeeds in scraping its assailant off by passing under a field gate. In some years a stoat family will remain together into the winter, hunting as a group; and where stoats are moving out of an area depleted of food such families may join together into a pack of twenty animals or more.

The change from summer brown to winter white is the result of a moult which begins sometime in November. The moult may take three weeks or longer, but in some years the stoat can change to white in two or three days. Such a quick change is possible because the white fur is almost completely grown in before the stoat begins to shed the brown. In some parts of its range, the stoat does not change at all. In others it may make a partial change, and it is possible to see white stoats, partially white stoats, and brown stoats in the same area. The white fur helps to conceal the stoat when snow is lying on the ground, but makes it highly conspicuous when there is no snow.

In Great Britain, the stoat is widely distributed. Ireland has its own race which hardly ever turns white, or even partially white in winter. The island of Jura also has its own race.

Man is probably the most important predator on the stoat, mainly by trapping and shooting. Foxes kill stoats and sometimes eat them. Dogs and cats kill them and do not eat them. Eagles and buzzards kill them and eat them. Young stoats are sometimes taken by owls and kestrels, but in Britain, at any rate, terriers and foxes are probably the main predators next to man.

The **Polecat** is found in most of the Palaearctic region, except the very far north, and fifteen subspecies have been described. It has been introduced into New Zealand. In Great Britain, it was once a common species and was found even in the Western Isles of Scotland, but by the beginning of the twentieth century it had been exterminated over most of its range. It is now confined mainly to Wales, although there may be a few in the English Lake District. In Scotland it is almost certainly extinct, but its place has been taken by feral polecat ferrets breeding wild.

In size, the polecat comes between the pine-marten and the stoat, measuring about $23^1/_2$ inches in length, including its tail. Its outer fur is dark brown, through which the yellowish under-fur shows clearly. The under parts are black, and the muzzle and the edge of the ears, white.

Almost any environment suits the polecat, so it is found near human habitations — in woods, meadows and fields, and on mountainsides. European polecats often spend the winter in a barn.

Forest or mountain animals will use hollow trees, or holes in rocks, or take over burrows deserted by rabbits or badgers.

The polecat feeds mainly on small mammals, rats and musk-rats, but it also takes birds, birds' eggs, frogs and fish. It is fond of water, is a good swimmer and will dive to capture prey. It has been observed digging frogs out of the mud. Like most of the Mustelids, it begins hunting after sunset.

All the martens have well developed scent glands under their tail, but among these the polecat is noted for its powerful smell. These scent glands, apart from their importance in marking territory, are important as a means of self-defence. If the polecat is threatened it secretes great quantities of a foul-smelling liquid, the smell of which is usually enough to hold off any dog, cat or fox.

The gestation period of the polecat lasts from forty to forty-three days. The female gives birth to one litter in a season, numbering from two to four young. The eyes of the young polecats open after thirty to thirty-six days. The young grow very quickly and are fully adult at the age of five months.

The **Asiatic Polecat** inhabits South-eastern Europe, Mongolia, North China and some of the southern provinces of the Soviet Union. In the last few decades it has spread widely in Czechoslovakia and is more numerous there than it used to be.

This species is also called the polecat of the steppes and differs from the common polecat in being of a lighter, more yellowish colour, particularly on the back and haunches. Only its limbs are dark, but it can be best distinguished by its two-colour tail, one half of which is light and the other half dark.

The distribution of the Asiatic polecat is about the same as that of the suslik which forms its main food.

The **Domestic Ferret** has been bred from the wild polecat. The most common type used by man is the albino which has of course pink eyes; but the dark type known as the polecat-ferret, which closely resembles the original wild type, is also commonly used. Domestic ferrets are frequently lost in rabbit burrows and thereafter may become feral. The albino type stands a poor chance of survival, but polecat-ferrets often survive and will interbreed freely with the wild stock. Many "polecats" seen in the wild state are in fact feral polecat-ferrets.

Zoologists once thought they could tell the difference between the true polecat and a gone-wild polecat-ferret by certain characteristics of the skull, but this is not reliable and it is almost impossible to tell one from the other under their skins.

Man uses the ferret for hunting rabbits. One way is to place purse-nets over all the entrances to the warren and then insert the ferret. The ferret travels through the burrow system and drives the rabbits out. When they bolt they are caught up in the purse-nets, from which they are removed and killed by the ferreter. A hungry ferret may kill the first rabbit it comes across and then lie up in the burrow. For this reason the ferret is partially fed before it goes to work, and confirmed killers are sometimes muzzled by their owners. Some rabbit catchers do not use nets; they stand by and shoot the rabbits as they bolt from the ferret.

Ferrets are easily kept and their requirements are modest. If they have a dry hutch and a warm bed they thrive and breed readily, but it is always advisable

to leave the female quietly with her kits for the first week or so. If disturbed too much, she may kill them. The young ferrets become tame and friendly if handled gently from an early age, and they soon grow accustomed to being carried around in a small ferret bag. Some individuals, however, remain unreliable throughout their lives and are inclined to bite.

Some people occasionally use the ferret for bolting rats from corn ricks and such places, and a ferret working in a warren where a vixen has taken up residence has been known to bolt fox cubs. But this is exceptional and any adult fox could kill a ferret.

A strong polecat-ferret that takes to the wild life is usually able to survive and feed well. It may live in rabbit burrows or holes in trees and will kill rabbits, voles, mice, rats and small birds. Curiously enough such animals, even after many months of living wild, often remain friendly with man and are easily reclaimed. Should they breed in the wild however, their kits will certainly be wild animals in every respect, including their general appearance.

European Mink

The **European Mink** is about the size of the polecat and measures from $13^3/_4$ to $15^3/_4$ inches in length, exclusive of tail. The overall colour of the fur is dark brown. The lower lip is always white and the upper lip occasionally white.

Formerly, the European mink was found over most of Europe. It has now disappeared from Central Europe but may still exist in France; otherwise it is found in Eastern Europe to Western Asia and the rivers Tobol and Irtysh. It disappeared from Bohemia and Moravia towards the end of the nineteenth century, the last specimen being shot in a pheasantry in 1896. This specimen can now be seen in the National Museum in Prague. Reports persisted of its occurrence in Slovakia, but it is always possible that the animals seen were escaped American minks.

One zoologist, discussing reports of European minks in Slovakia, has written:

"It is of course true that in Slovakia there are many places where the European mink might still exist. I, myself, visited a certain stream where, a year before, a hunting dog had caught a mink. Mink droppings containing fish bones were found about the stream, but, during our excursion in 1963 we found no further trace of mink. The specimen caught by the dog cannot be identified with certainty because its skull had been crushed. So we can do nothing but wait for a possible recurrence of this rare creature before we can be certain."

It is incorrect that the European mink lives only on the banks of mountain streams. On the contrary, it was found in Central Europe beside stagnant water,

in swamps, and in the dead backwaters of rivers. That is why it survived longest in Southern Bohemia. The mink digs its burrow in the bank, with the sleeping chamber above water level, and drives an airshaft to the surface. However, there are records of nests in reed beds, hollow trees, or under the roots of trees on the shore.

The European mink is well adapted for its semi-aquatic life. While it spends most of its life on shore, it is an accomplished swimmer and diver with slightly webbed toes and a dense waterproof coat. On the ground, it moves like the polecat. It will take almost anything it can catch and hold and is known to feed on fish, frogs, mice, birds, birds' eggs, earthworms and molluscs. Where it lives close to human habitations, it will sometimes raid pigeon-lofts and chicken-houses and has been reported killing adult poultry. But the killing of hens is quite exceptional and occurs only where mink are too numerous on the ground.

The mating season is from February to March and the usual litter size is from two to six young.

The **American Mink,** often known simply as the Mink, is slightly bigger than the European species and differs from it mainly in having no white on its upper lip. This species inhabits the North American forest zone from Alaska and Northern Canada down to Florida, New Mexico and California. It is, of course, now feral in many parts of Europe, including the British Isles.

Most of the mink furs sold nowadays come from ranched animals. Even in North America where the animals exist in the wild state, mink breeding is a highly profitable business. In Britain and

American Mink

Europe generally, wild populations have become established as the result of escapes from these farms. Even in the Soviet Union, which is the home of the European mink, the American species is ranched and has also been introduced as a wild animal. The same is true of Scandinavia. The evidence available suggests that the native mink is declining in those areas where the American species has settled. The world production of mink furs now totals more than 1,500,000.

In its native America, the mink takes a variety of food, especially aquatic species. In winter, it feeds mainly on mammals but its summer diet includes crayfish.

The general colour of the American mink is dark brown, with a small white spot on the lower lip. Males are much bigger than females. Ranchers have bred a variety of colour mutants from black to *Sapphire* and *Silverblu*, and these colours have all been noted in feral British populations. It now seems very likely that Great Britain will have the American mink as a permanent resident, like the American grey squirrel.

The largest member of the Mustelidae is the **Wolverine,** or **Glutton,** which is over 3 feet in length including its tail and weighs up to 70 pounds. Its fur is uniformly brown with pale markings on its head and flanks. The wolverine is found mainly in the forest-covered tundras of Northern Europe.

Because of its heavy build, the wolverine at first sight appears to be a clumsy animal, but it can move at great speed and catch nimble species larger and smaller than itself. It moves in great, arched bounds and touches down on all fours. In deep snow it is tireless. It is an expert tree climber and a good swimmer.

The wolverine feeds principally on rodents such as the lemming, but will hunt almost anything that moves including beavers, hares, foxes, martens, birds and fish. It is fond of birds' eggs and eats a variety of fruits. Being tremendously strong it is able to kill prey much bigger than itself. When hunting big prey it crouches flat on the branch of a tree and then leaps on to the victim's back.

Wolverine

In this way it is able to kill roebucks or the calves of larger deer species, and it has been clearly established that it will attack even the reindeer and the moose. Animals of this great size are usually attacked while they are swimming across wide rivers, so that they are unable to use their greatest weapon, their hoofs.

People living in the far north do not take kindly to the wolverine, because it sometimes sneaks into houses to steal dead poultry and other food. In such cases, it is also something of a wrecker, turning the place upside down.

Despite its strength and its reputation for savagery, the wolverine, if taken young, becomes completely tame and can make an attractive pet. Like all the martens, it loves to play and is active the whole day long. In zoos, wolverines have to be kept in specially strong cages because of their immense strength of teeth and claw. They breed freely in captivity. The gestation period is four months and the usual litter size two to four young which are blind for some time after birth.

Peter Krott, the Austrian naturalist, reared thirty-eight young wolverines some years ago and was able to summon them out of the forest by calling to them. Later, he let his wolverines run wild over a large area of forest, where they bred, and he was able to observe their habits over a two-year period. This led to friction with many hunting and shooting men, but provided excellent opportunities for studying wolverines in the wild state because these truly wild animals tolerated Krott's presence among them.

The **Ratel,** or **Honey Badger,** is another large Mustelid, measuring 4 feet in length, including its tail. The fur on its back, flanks, and tail, is ash-grey. The

under-fur is blackish-brown and there is a clear line of demarcation between the zones.

This species inhabits rocky regions of Africa south of the Sahara. It has short, powerful legs and long, sharp claws, and is an excellent digger. When threatened by an enemy, it can burrow out of sight at high speed and disappear literally in a few seconds. The honey badger feeds on small mammals, birds and their eggs, as well as snakes, slugs, frogs and worms. In addition to these it eats a variety of sweet fruits, roots and bulbous plants, but best of all it loves honey. Whenever it discovers a nest of wild bees, it digs it out and eats the honey on the spot. Its thick fur and skin protects it from the stings of the bees.

An interesting form of co-operation between the honey badger and a species of woodpecker known as the honey-guide has recently been discovered. As soon as the bird discovers a nest of wild bees it tries to attract a honey-badger to the spot, drawing attention to itself by its conspicuous behaviour and by a sound produced by the vibration of its tail feathers. As soon as the honey-badger hears this sound, it seeks out the bird and is guided by it to the bees' nest. The honey-badger digs out the nest and eats the honey, leaving the bees' larvae for the bird. Thus badger and woodpecker profit jointly.

Ratel

Badgers are thick-set, powerful animals which walk on the soles of their feet and are, therefore, known as plantigrades. Animals like cats and dogs walk only on their toes and are, therefore, known as digitigrades. Almost all the badgers are excellent burrowers and feed on a mixed diet.

The **European Badger** is found in Europe, across Asia to Japan, and on some of the Mediterranean islands. Twenty-four sub-species have been described, based on size, slight variation of teeth and so on, but it is doubtful if they are all justified. Badgers are widely distributed in the British Isles.

In general appearance the badger resembles a small bear. Its upper fur appears grey because the hairs are pale at the base and the tip with a black band between. The under-fur, the legs, feet and claws are black. There is some variation in the colour of the coat — black, reddish-brown, buff and cream animals having been recorded. The face is white with black stripes and this black and white pattern is conspicuous at all times, even on the darkest night. It is probably a warning pattern.

The sexes cannot be told apart merely by looking at them, although the boars are broad-faced and the sows slender-faced. Cubs, on the other hand, are easily identified in summer by their small size. In the autumn, when the cubs have reached adult size, all badgers look alike in the field. A fully-grown badger will measure 3 feet in overall length, including about

4 inches of tail. Weight varies widely and even seasonally. For example, badgers are much heavier in the autumn than they are in the spring. Twenty-five pounds is a common weight, but animals of 30 are not unusual, and weights of 40 pounds are quite regularly recorded. There are even records of animals weighing up to 60 pounds. Boars are consistently heavier than sows.

Because of its retiring habits, the badger is often present where its presence is unsuspected. It is nocturnal at all seasons of the year, emerging from its sett sometime after sunset and returning before sunrise. In the spring, which is the main mating season, a pair of badgers may occasionally be seen above ground in good light during the day. But this is usually in remote areas where they are little disturbed. In secluded mountain areas, badgers, like mountain foxes, occasionally have their cubs above ground among rocks or heather, and it is then possible to put the beasts on foot in the open during daylight.

An established badger sett is always easily recognised because of the great earthworks beside each entrance hole. Some of these heaps amount to a cartload of soil, or more. A big sett will have many entrances and cover a wide area. New setts begin as a single burrow with a heap of earth at the entrance, but if the animals stay there to found a new colony more burrows will be excavated and more heaps of soil will appear. Sandy ground attracts the badger because of the easy digging, and sometimes the animals will occupy the same warren as rabbits. An established badger sett sometimes has a fox as a lodger.

Generally speaking, the badger likes rolling hillocky country with woodland and forests, in lowland or mountains. It avoids bogs and other low-lying areas which are liable to be flooded. It likes woods on hillsides, wooded knolls, rabbit warrens and cliffs, and is found in mountain cairns up to 1,500 feet.

In Britain, badger cubs are born between January and May but usually in February or March, February in the south of England and March in Scotland. The sow badger mates in spring after the birth of her cubs, most usually in the period from February to May. There is a later mating period from July to October, but the main breeding period is in the spring. As in the marten, there is a long but variable period of delayed implantation. A badger which mates in March will produce her young a year later; a badger mated in May will produce her young ten months later and a badger mated in August will produce her young seven months later. This is, however, variation in the period of delayed implantation, not in the period of development after implantation.

The number of cubs varies from one to five, but three is a fair average for Great Britain. The cubs begin to appear outside the sett at the age of eight weeks and are weaned when about three months old. In the early days, after weaning, the sow badger will regurgitate partially digested food for them. While the young animals may leave their parents in the autumn, they are just as likely to remain with them through the winter, for badgers are sociable and the residents in one sett will visit their neighbours in another. Young badgers in spring may dig a temporary burrow away from the main sett while the old sow is having her cubs.

Mountain badgers frequently have their cubs in cairns or holes in rocks.

The badger takes a great variety of

animal and vegetable food. Animal food includes rabbits and rats, voles, hedgehogs, beetles, earthworms, snails, frogs and newts. All badgers like wasp grubs and will tear out wasp's nests in late summer. Few of them attack poultry and it is most exceptional for a badger to kill a lamb. Surprisingly, earthworms are one of the most important items on the badger's prey list. Vegetable matter eaten includes grass, bluebell bulbs, earth nuts and other underground storage organs. Other food recorded includes acorns, beech mast, blackberries, the hips of the dog rose, and fruits of all kinds shaken from the trees by the wind. Almost any food eaten by dogs and cats will be eaten by wild badgers.

Compared with other beasts of prey, the badger's teeth are the least adapted for catching and feeding on other animals. Its molars have wide crowns designed for chewing vegetable rather than animal food. Analyses of the contents of stomachs from Europe show that there it eats earthworms, slugs, snails, insects, mice, rats, porcupines, eggs, acorns, mushrooms, roots and fruits. Young rabbits are a common prey item. This closely resembles the food lists drawn up by Ernest Neal whose book, *The Badger,* is the best monograph yet available on this animal.

There is a record by Stephen of a badger hunting rats in a farmyard. A rat had a nest in a great heap of frozen sand. The badger tried to claw through the entrance hole, but the sand was like granite in the frost and the animal's claws could make no impression on it. Later, when the hole was opened with a pick, a terrier killed ten young rats and their mother. The bodies were laid out on the heap of sand and that night the badger was observed returning to the spot and eating them there.

A report from Czechoslovakia tells of a badger which was accidentally killed in the city of Prague. An autopsy was carried out in the Zoological Institute of Charles University. The autopsy showed that the animal was in excellent condition and was covered with a thick layer of fat. The remains of sewer rats were found in its stomach and it was evidently the presence of these that had attracted the animal into Prague from the neighbouring woodlands.

Although the badger lays on a store of fat in the autumn to help it survive the winter, it does not hibernate, as anyone can discover who watches a sett during the winter months. The animals may lie up for several nights during storms and blizzards, but when the weather settles they will come out to hunt. In any case, they often take a look out on the wildest nights, even if they do not emerge. The badger is well able to go for many days without food, because when food is plentiful it gorges to capacity.

Unlike the fox, which is a dirty housekeeper, the badger keeps its sett scrupulously clean and digs small pits outside which it uses as latrines. Food is not carried right into the sett, therefore the burrows do not become fouled up with the remains of prey. The underground tunnels may be ten to fifteen feet below ground

European Badger

level and thirty feet in length. They link up sleeping chambers and breeding chambers. The chambers in current use are lined with bracken, or hay, which is regularly changed. Big cleanings take place in autumn and in spring and used bedding is generally disposed of in some hole near at hand. Ventilation shafts are also dug to admit air but are sometimes hidden by fallen leaves. The badgers are forever digging and excavating new soil.

Dead animals are usually buried below ground and the burial place sealed off from the main tunnels. Years later, a new generation of badgers may re-open the closed burrow, in which case the skulls of the dead badgers are often scraped out along with the soil and can be picked up in the heap at the entrance to the sett. There is one British record of badgers carrying a dead animal out of the sett and burying it in a specially dug grave near at hand. This incident was recorded by Brian Vesey-Fitzgerald.

Young badgers are often kept as pets. If taken young enough they tame easily, like most of the Mustelids, and will follow their owner about like a dog. They are not particular about food, and can be kept in the home because they do not smell. Being naturally clean in its habits the badger can be house-trained like a dog. Unfortunately, being nocturnal, it becomes active and noisy at night and shows little inclination to play about during the day.

The badger's main enemy is man and because its sett is often used as a refuge by a hunted fox, it suffers doubly. When terriers are put to earth to bolt the fox they are often mauled by the badgers, which does not endear them to the dogs' owners. In Britain it is illegal to set steel traps for badgers or to gas them, which does not save them from being trapped and gassed. There is also in England the so-called sport of Badger Digging, which has been described by Ernest Neal. The badgers are prevented from digging by terriers, then are caught by tongs and placed in sacks. This is justified when the badgers have to be taken somewhere else and released, but such digs often end in the animal being turned loose among terriers to be mauled. This is baiting and quite illegal in Great Britain.

Where foxes and badgers share the same sett they occupy different parts of it, and observation suggests that the families do not mix. Again, this association often spells trouble for the badger, because, when the fox hunters arrive with terriers to kill fox cubs, the badger naturally attacks the invading dogs. After all, the badger does not realise that the dogs are after the foxes. In any case, the sett is *his* home, so he defends it.

British and European zoologists are agreed that the badger, so far as man is concerned, is one of the most useful beasts of prey and ought to be protected by law.

The **American Badger** is distributed over a wide area of the North American continent, from 58° Latitude down to Mexico. It is about $27\frac{1}{2}$ inches long, including its tail of 6 inches. In many ways it resembles the European badger, but it is a smaller and squatter animal. Heck has described it as follows:

"It looks like a tortoise, or as if somebody had flattened out a European badger. It is light grey above, grizzled with black and white; a white stripe runs from the nose to the back and it also has white spots on the sides of its head."

The American badger is an expert burrower and is equipped with powerful fore-

VIII 1. *Pine-marten* 2. *Sable* 3. *Beech-marten* 4. *Polecat* 5. *Asiatic Polecat* 6. *Striped Skunk* 7. *Domestic Ferret* 8. *Marbled Polecat* 9. *Wolverine*

paws and claws. It can dig tunnels up to thirty-five feet in length. No burrowing rodent is safe from this species as it can dig them out no matter where they are. It preys upon prairie dogs and other rodents of the plain. It also eats snakes, insects, a wide variety of small mammals, and birds' eggs. Its diet, therefore, is very much the same as that of the European badger.

This species lies up for long periods during the cold season or prolonged drought, but does not hibernate in the true sense of the word.

American Badger

The **Striped Skunk** is one of the most interesting members of this subfamily, not least in its appearance. It is black, with a white stripe from the nose to the eye, and two striking white bands running along the sides of its body to the tail. Because of its handsome fur, the skunk has always been in great demand by the fur industry, and before the war over a million skins of this animal were used annually. Of course, not all of these skins came from wild skunks; most came from animals bred on special farms.

The main habitat of the skunk in North America is forest and bushy areas, especially close to river banks.

The skunk has the most highly specialised anal glands of all the Mustelids. In the majority of Mustelids, the secretion of these glands is used for marking territory or as a form of advertisement between the sexes. The skunk has two such glands, one on each side of the tail, which are about the size of beech nuts. By muscular contraction, the skunk is able to squirt out the contents of these glands for a distance of several yards. The fluid ejected is yellow and oily, and nauseous in the extreme. Although its chemistry is not known it contains a high proportion of sulphur.

This is, therefore, a chemical weapon and a highly efficient one, capable of halting any would-be attacker in its tracks, even the most savage dog. A dog, or any other animal, sprayed in this way immediately rolls on the ground as though in a fit, digging and whining and trying to rid itself of the nauseating fluid. Human beings find the smell of the fluid nauseating, and highly sensitive people will vomit, develop acute headaches, or even faint. Other people can tolerate the smell without ill effect. The smell can be removed from clothing only by heat, which accelerates evaporation. Nevertheless, it takes about one month for all smell to vanish from clothing and shoes.

Possession of such a terrible weapon enables the skunk to go about its affairs with apparent unconcern. If it is approached by an enemy, it does not run away; instead it takes up a defence posture, with its tail raised and curled over on to its back, and its hind-quarters turned towards the enemy. Wise animals leave it alone and an experienced dog will not attack a skunk.

Like other Mustelids, the skunk is a

predator. It feeds mainly on frogs, small mammals and birds, but also eats insects, worms, bulbs and roots.

If taken young, the skunk can easily be tamed. It thrives in captivity and is an asset to any zoo. So long as it is not irritated or upset it gives off no smell at all. Like the badger, it is scrupulously clean in its personal habits. Nevertheless, just to be on the safe side, zoo authorities usually arrange to have its offensive glands surgically removed.

Vogel, the well-known zoologist, has written about a skunk that he kept in captivity:

"The animal was not at all snappish but retained all its wild habits, despite its long period of captivity. Every time it heard a strange, rustling noise or other suspicious sound, it would stiffen, its bright eyes bulging and the white hair on its flanks bristling. A further noise or unusual movement, like the swinging of a towel, caused it to stamp heavily with its hind feet, arch its back and lay its tail along it, with its hind-quarters turned towards the sound or movement, despite the fact that its glands had been removed. If the glands had been present and functioning, there is no doubt that a squirt of the brownish-yellow liquid would have accompanied such demonstrations. Otherwise, the skunk was playful and friendly towards man and never used its teeth or claws seriously. If given a small rubber ball it would first of all try to eat it, then it would roll it around with all the skill of a cat. It would also play for a while with a crushed piece of paper, or a hare's foot. It was energetic and acrobatic and liked climbing on to a coal box and jumping awkwardly down again, apparently greatly pleased with itself. It loved to stand on its hind legs in a corner of the room and would hold such a pose for long periods, sniffing about it all the time. However, it did this only when it smelt food close at hand. The act of cooking, and later the mere opening of the pantry door, attracted its attention, so it would stop playing and run towards the place where the smell of food was coming from. It seemed insatiable and even after eating a great quantity of food it was always able to discover room for more. Its gluttony was extraordinary."

London Zoo had a tame and beautifully coloured skunk which once appeared on television. The transmission was live and viewers had the experience of seeing an unrehearsed and unexpected drama. Nobody on the programme was expecting any trouble, not even the director of the zoo, who had brought the skunk along and who was convinced that its anal glands had been removed. The programme continued without mishap until one of the cameras tracked into the skunk too close for its liking. The skunk took up its menacing defence posture and when the large, curious object kept coming closer and closer, it contracted its muscles and squirted out a stream of its terrible fluid. The report of this adventure ends briefly with the sentence:

"That evening London television had to discontinue its programmes for technical reasons."

Otters are carnivores, specially adapted for a life in the water. They have webbed feet and their long, slender bodies are covered with dense fur, which is waterproof and valuable.

The **Common Otter** inhabits Europe, Asia and North America. A dog otter will measure $4^1/_4$ feet in length, including his rudder-like tail. Bitches are smaller and measure about $3^1/_2$ feet. In both sexes the tail is more than half the length of the body. Bitch otters will weigh from 15 to 18 pounds, dogs from 20 to 25 pounds, but 30-pounders are common enough and animals up to 50 pounds have been recorded.

In some ways, otters resemble seals. They have a layer of fat like the seal's blubber, although it never reaches such thickness. The otter is streamlined like a seal, has a heavy growth of sensitive whiskers on its upper lip, and special muscles for closing its nostrils and its ears when it dives. The colour of the fur is brown, slightly darker in winter than in summer. While it is swimming the otter is insulated against the cold by the air bubbles trapped in its fur.

Underwater, the otter is guided not only by sight but by its sense of touch. The whiskers on its muzzle, like the whiskers of the seal, are tactile hairs, the roots of which are fitted with receptors for transmitting signals to the nerves. This special arrangement enables the otter to move and fish in muddy waters. The animal's intestine is specially adapted for dealing with fish. Fish bones cannot damage the intestine because its walls shrink immediately and form a small obstruction which pushes the bone away.

Fish is the otter's main diet, but it also feeds on frogs, small mammals and birds. During a winter freeze-up, it will travel some distance from the river and catch rabbits beside their burrows. It will stalk such birds as moorhens on ice, and in open water will swim under them and pull them down. Eels are a main item of food.

Man has long waged war on the otter because of its predation on fish, with the result that it has become extinct in many parts of Europe. For this, anglers must bear the main responsibility. In Great Britain, anglers are divided in their attitude to the otter, but most of them now accept it as a predator of no particular significance. Not so long ago, at a fishing exhibition in Europe, a poster was exhibited bearing the inscription: "Annihilation to Otters".

Predation by otters is of no significance in rivers where, in fact, its main prey is often eels. On a fish farm, however, or at a fish pond, it can naturally wreak havoc, so is not tolerated there. Its main enemy is man, who shoots it and traps it. It is also hunted with special hounds and this results in bitch otters being killed at the time when they are carrying or feeding cubs.

The otter is most usually found on rivers, lowland lakes, or mountain or moorland lochs. It is also found by the

Common Otter

sea, living in sea caves; but the water, whether salt or fresh, must be clean and polluted rivers do not appeal to it. The den, which is known as a holt, is by the riverside or not very far from it, or in a hollow in a banking or under the roots of a tree. The same holt will be used by succeeding generations of otters, as will the same boulders in midstream, the same crossing places, and the same pathways.

Otter cubs are born in all months of the year and there is no evidence of any peak breeding period. Litter size is usually two or three young, but up to five have been recorded. Very little is known about the actual breeding of otters, but the gestation period is reckoned at two months.

It is a curious fact that otter cubs do not take to the water willingly. They have to be pushed in, or coaxed in by the bitch otter. She often persuades them to swim by witholding food from them. Once they are in the water, they soon develop their full powers and are taught the art of hunting fish. The part played by the dog otter is not clear, but the evidence suggests that he takes little interest in the cubs after they are in the water.

The prey list of the otter, made up from British sources, includes eels, coarse fish, trout, salmon, freshwater crayfish, water birds, rats, water voles, field voles, frogs and newts. At the seaside it takes crabs, mussels and probably rock fish. It has been known to eat gulls and their eggs, poultry, ducks, rabbits, leverets and carrion.

Otters have long been noted as wanderers, but it is still far from clear which animals wander, or why. They could be young animals dispersing from the paternal territory, or adults in search of a territory of their own. It is, however, perfectly true that animals will cross from one river to another overland, and that travelling animals will use the same trails as previous generations. The most settled time is during the breeding season and the dog otter will remain with the bitch until after the cubs are weaned. According to otter hunters, the animals are spread out evenly at intervals of about five miles on the best rivers.

Some of the otter's habits suggest that it is territorial, like the stoat, weasel and pine-marten. Under its tail it has a gland with which it sets scent on logs, branches, boulders and tufts of vegetation along the river bank. It also deposits its droppings in prominent places and these two habits are usually indications of territorial behaviour.

The **Sea Otter** originally inhabited the shores of the Pacific Ocean in North America, north of Oregon, and in Asia up to the Kuril Islands. Human predation has considerably reduced its range and it has been brought close to the verge of extinction.

The story of the sea otter is a tragically familiar one. The animal happens to possess a magnificent coat. During the first fifty years after the discovery of the Commander Islands, 120,000 sea otters were killed each year. In the twentieth century, the thousands had become scores, or even dozens, and even before the First World War a single pelt was fetching an exorbitant price.

Thanks to strict protection measures introduced by the American and Soviet governments, the sea otter is beginning to show some increase in numbers and there is no immediate danger of its extinction.

The Russian zoologist, Marakov, has published some of the results of his work

on the sea otters of the Commander Islands.

"Sea otters live in groups of twenty or thirty, up to several hundreds of animals. Such groups are made up of adults, sexually mature young animals, and females with young. The general appearance of the sea otter reminds one of the common otter, but it is a much larger animal. Its hind limbs are like fins and its front paws are shaped like rough mobile cushions so that it is difficult to distinguish the toes. The body is covered with very fine fur which varies in colour from light-brown to black. As the animal grows older, its head, crown and chest become whitish with a flush of orange. Unlike the true mammals of the sea — whales and seals for example — the sea otter has no subcutaneous layer of blubber. Only its fur insulates it from the cold. Gulls are always to be seen flying close to feeding sea otters, waiting to pick up the remains of their prey. The female sea otter is an attentive mother. After a gestation period of eight to nine months she bears one young and takes care of it for one and a half years, keeping it always with her. The male does not share in rearing the young. Many experiments have been carried out in the past with the breeding of sea otters in captivity, but there were always difficulties in feeding them, as they required special sea food."

Sea Otter

The sea otter measures 5 feet in length and weighs up to 88 pounds. It is even a better swimmer than the common otter. It feeds mostly on sea urchins (60 per cent. of its food), but also on shellfish and crabs. Fish are rarely eaten.

RACOONS

Family PROCYONIDAE

This is the smallest family among the carnivores. Its members are related to the bears from which they differ in the conformation of their skull, their small size, and their long, bushy tails. Most of them are hardly bigger than a cat. They are all plantigrades and walk on the whole sole of the foot. They are omnivorous, as the wide crowns of their molars indicate.

The **Racoon** measures from $31^1/_2$ to $39^1/_2$ inches in length which includes its long tail. The fur is yellowish-grey with individual black hairs. On the nose it has a black stripe and around the eyes are blackish-brown spectacles, rimmed with yellowish-white. The tail is greyish-yellow with near-black rings.

Racoon

North America is the home of the racoon.

It is found near rivers and lakes and its fondness for water is proverbial as can be seen by observing racoons in zoos, where the animals will wash anything they can lay their paws on. The racoon holds the object to be washed in its hand-like forepaws and starts rubbing it in the water. Wild racoons wash their prey in this fashion. They will often try to wash sugar cubes thrown to them by visitors, with the result that the cubes dissolve in their paws. The reason for this peculiar behaviour has so far not been satisfactorily explained.

In the wild state, racoons live in small groups composed of a single male and several females. The animals lie up during the day and emerge at nightfall to hunt over their territory. Their sense of smell is highly developed and they rarely miss anything edible within smelling distance. They climb trees with great agility and are excellent swimmers. They feed on small birds and mammals as well as lobsters, tortoises and birds' eggs. Like all the members of this family they are omnivorous, although meat in some form forms the bulk of their diet.

Visitors to zoos find racoons amusing because they are playful and mischievous. The Americans have reservations about them because they know only too well the damage racoons can cause if they become too numerous. A racoon which finds its way into a dovecot, or chicken house, is as destructive as any fox. As a result, the species is hunted almost everywhere. Its fur is of considerable economic value. Over a million pelts are sold each year in the United States. Despite this rate of killing the racoon continues to flourish and is still a common animal of rivers and forested regions.

The racoon is easy to keep in captivity. It breeds without any trouble and the female produces from four to five young after a gestation period of sixty-three to sixty-five days.

The **Ring-tailed Cat** has the head of a cat but is more like a small fox in size and general appearance. It measures $37^1/_2$ inches in length, including its tail of $15^3/_4$ inches, which is long and thick with dark stripes. The fine fur is greyish-brown in colour.

This species inhabits the South-western United States and Mexico. Although not a rare animal, it is seldom seen because it is extremely shy and strictly nocturnal. In Mexico, the ring-tailed cat is called *Cacamizli*. Audubon has described it as follows:

"A *cacamizli,* although it is shy and distrustful, is easily tamed and after it has been kept in a cage for a long period it can be allowed to run freely about the house. It will become everybody's pet and will be most useful for catching mice and rats. I saw a tame ring-tailed cat running about the streets of a small Mexican town."

The ring-tailed cat feeds on small birds, mammals and insects and is said to be able to fish.

The **Coati,** or **Coati-mundi,** is another member of this family. It is more than 36 inches in length, including its tail, and has a conspicuously elongated head with a turned-up nose. Its coat is reddish-brown in colour and its tail is ringed with black.

This is mainly a South American species but its range extends into the southern areas of North America.

The coati is a skilful climber and a good runner. When climbing or running it carries its tail up straight. When hunting, it relies mainly on its sense of smell, but is also guided by its sense of touch. It is omnivorous and feeds on fruits, insects, slugs, snails, small birds, birds' eggs and small mammals. During its hunting it probes with its long nose into every likely crevice and hollow.

Because of its liveliness and attractive appearance, the coati is very popular in zoos. If taken young it tames quite easily and soon learns to follow its master about everywhere. The female has from four to five young at a birth and the gestation period is seventy-seven days.

The **Giant Panda** measures 5 feet in length and is the largest member of this family. Because of its almost invisible tail it was at one time classified with the bears which it superficially resembles. The panda's thick fur is yellowish-white and it has black rings round its eyes, black ears, black legs and a black stripe across its shoulders.

Nobody knew about the giant panda's existence until 1870, when it was discovered by the famous missionary naturalist, Père David, high up in the mount-

Ring-tailed Cat

Coati

Giant Panda

ains of Tibet and China. It is an inhabitant of bamboo forests and lives almost entirely on bamboo shoots. Because of its extreme rarity little is known about its habits in the wild. Nevertheless, it is known throughout the world because of the publicity it has received. Toy pandas are now as widely manufactured as Teddy Bears. The emblem of The World Wildlife Fund is a panda.

The giant panda is one of the rarest of large mammals and breeds only rarely in captivity. It has been said that not more than twenty wild pandas have been studied under natural conditions.

The panda's forefeet are remarkably adapted for its highly specialised life as a bamboo feeder. It has a special, elongated wrist-bone which can be used as a sixth finger, thus enabling the panda to clasp firmly the slenderest lengths of bamboo. Why it should be so boldly marked remains a mystery. One guess is that the black and white pattern breaks up its outline against a snowy background.

BEARS

Family URSIDAE

The last family of the carnivores contains the largest living beasts of prey. They are plantigrades because they step on the whole sole of the foot and can be recognised at once by their thickset bodies. Their teeth indicate that most of them are not really adapted to hunting living prey. They are, rather, omnivorous as can be seen from their small incisors and large molars with rugged ridges.

Bears are kept in captivity all over the world and no zoological garden would be complete without one; nor would any circus. It is widely believed that bears are good-natured and easily tamed, but they are in fact more dangerous than the tiger and their apparent good nature is deceiving. A bear's moods are not noticeably betrayed by its behaviour or its general expression, so one can never really be certain whether it is relaxed or excited, pleased or angry. A bear becomes easily irritated and attacks immediately. It has to be borne in mind, however, that these remarks apply to captive bears or to animals which have in some other way, lost their fear of man. Truly wild bears, like almost all truly wild animals, are rarely a threat to human beings.

The **European Brown Bear** once inhabited the whole of Europe but is now confined to the Pyrenees, Abbruzzi, the Balkans, Czechoslovakia, Poland and the Soviet Union. It also inhabits Asia and North America. The species was found in Scotland until the tenth century, and it is a matter of history that the invading Romans captured the giant bears of Caledon for their brutal circuses in Rome.

So far as Western Europe is concerned, Czechoslovakia appears to have most of the bears still living, and the most recent estimate is that there are two hundred in the Slovak mountains. Numbers have been steadily increasing during the last twenty years as the result of the most stringent protection regulations.

As a result of its wide distribution, the brown bear has produced many geographical races and even in one area shows great variation in colouring. In Slovakia alone there are black-brown and coffee-brown bears and light coloured animals are not rare. The European bear also conforms to the so-called Bergmann's Rule that animals of the same species decrease in size towards the equator. Animals from the far north are in fact larger than those from southern areas and by all accounts the bears of the old Caledonian forest of Scotland were huge animals. A present-day example is the North American Grizzly Bear, which is now considered to be no more than a geographical race of the European brown bear.

The smallest bears live in Southern Europe and weigh at most about 4 hundredweight. Asiatic bears are heavier and the Kamchatka brown bear will weigh up to nearly 8 hundredweights, but the real giants of the species are found in Alaska where the bears of Kodiak island reach a length of 9 feet and weigh about 15 hundredweights. Compared with these giants, the bears of Southern Europe are mere cubs.

The European bear inhabits thick forests with rocky fastnesses which are difficult of access. The den is in a cave or under an uprooted tree. The bear becomes active after sunset when it comes out in search of food. It feeds on berries, buds, nuts, fruits and mushrooms and will take insects, slugs, snails, snakes and birds. Best of all, however, it loves honey.

Some of the Alaskan bears fish for salmon but seldom attack larger animals.

It has been suggested that man actually taught the brown bear to be a carnivore because hunters used to bait them with dead hares, cows, or other livestock. The bears became accustomed to eating such meat and began attacking forest game and herds of cattle, thus causing considerable damage to man's interest.

Professor Komarek has described his experience with a carnivorous bear:

"Once I entered a vast forest that stretched to the horizon. Suddenly, I saw a large, dark body among some shrubby beeches and tree trunks. Presently, the dark body moved and a great bear jumped into the open. It was a most impressive sight and if someone had ordered me to shoot such a wonderful animal I could not have brought myself to do it. In the evening light the bear appeared as black as coal, but as he bent down and began sniffing the ground with a swaying motion of his head, we could see quite clearly between the shoulders, the irregular white star on its back.

"The bear moved and with long strides began walking down the slope. At that moment a small deer jumped out of the bushes right in front of the bear and tried to flee. The bear immediately made its attack, and bounded forward in one great leap with bewildering speed, looking as though it were made of rubber. I would never have believed that an animal that looked so heavy could leap as lightly as a fox. With its third leap it reached the kid and with a single blow from a paw crushed the life out of it. It snatched the small body up in its great teeth and disappeared into the thick bushes with the

carcass hanging from its jaws. I could still hear the snuffling of it after it was gone."

Professor Komarek goes on to make the point that while a human being might consider such a killing as murder, it is in fact all a part of natural predation. This bear was a carnivore and, therefore, killed to live. The professor also suggests that it was probably a bear that had been fed meat and could not break itself of the habit.

Generally speaking, the bear has to be classed as an animal little adapted to hunting large game. Rather will it take wounded game or sickly game or carrion. This is shown not only by its teeth but by its relative slowness of movement. Although it is capable of swift attack, it is nevertheless too slow to catch a healthy roebuck or stag, but it may kill one from ambush. It is perfectly true that bear dung often reveals the hair of roe and other deer in it, but the animal is known to be a carrion eater and in spring will claw its way into great heaps of snow expecting to find a dead animal underneath. Not all zoologists would agree with Professor Komarek's view that bears are turned into carnivores by man.

Despite what has been said about the bear's slow movements, it is by no means a clumsy animal; it can climb and leap very well and over a short distance could keep pace with a horse. Like all the bears the brown bear is a very good swimmer.

The brown bear spends most of the winter asleep in its den, but it wakes up and emerges occasionally, so its winter sleep is not true hibernation as in the case of a marmot. It is normal, prolonged sleep and there is no drop in body temperature. During the period of sleep, the bear lives on the fat reserves of its body. This layer of fat is laid on during the autumn when the bear feeds to capacity.

During the winter, the female bear gives birth to her young. The mating period is in April and May, but as in the case of the badger and a number of other animals, there is no real development of the young until the end of the summer. The extended period of gestation lasts nearly eight to nine months.

The bear cubs are born in midwinter during the coldest of the weather and the family may number two to five. At birth the cubs are ridiculously small, no bigger than a rat, and they are blind for five weeks. The she-bear protects them carefully against the cold and gathers them with her paw against her thick fur. The young bears are highly sensitive to cold.

The lair of the nursing she-bear is easily recognised because the cries of the suckling young can be heard from some distance away. When spring comes to the mountains, the bear leaves her winter quarters with her four-month-old cubs.

Bear cubs are charming and playful little animals. They play tricks on each other and never leave their mother in peace for a moment, attacking her, biting her and scratching her on the nose and ears. But she is a good mother and patiently tolerates every kind of boisterous play. At first, the young bears have a collar of lighter coloured fur. If she imagines that her family is threatened, a she-bear with young can be dangerous, even to man. She is completely brave and will attack at once if there is a threat, or the suggestion of a threat. Because of its gigantic strength a brown bear can easily kill a man, but when this happens it is almost invariably due to human carelessness. For example, someone finds a lost bear cub and tries to catch it. Then, as

European Brown Bear

soon as the cub starts whining, the mother bear appears and sees her young being attacked. So she attacks in defence of her cub.

In this book, *Hunting in the Carpathian Mountains,* Dr. Komarek describes an incident with a happy ending:

"An old farmer was alone at home one afternoon, working in the courtyard. He had no dogs because, in the spring, they had left with the cattle for the pasture lands and had not yet returned. Suddenly, he noticed that the poultry were running headlong from the orchard to the courtyard and into the stable. Wondering what was happening he went into the garden and, there, he saw a bear cub trying to climb a young plum tree.

"The cub climbed to the top of the tree, and at this the man became angry. Already his orchard was half-destroyed by the bears. He started to beat the cub with a club; the cub began to squeak and tried to come down the tree backwards. Just then, the farmer heard a suspicious muttering behind him and he turned around just in time to see a she-bear running towards him from the forest. The man became terrified and, instead of running, started climbing the nearest strong tree.

"It happened to be a sturdy plum tree. By the time the man reached the top, the she-bear was already underneath, biting the trunk and tearing furiously at the bark with her claws. Finally, she stood up on her hind legs and began snapping off all the branches within reach, pulling them down and tearing them from the tree. The man was standing, or hanging, in the top of the plum tree, fortunately outside the bear's reach, and yelling for help. He could not climb any higher and was afraid the bear would climb up the tree after him. The she-bear, however, soon tired of the whole business and turned to look for her cub, which was not in a hurry to come down from the small, low tree into which it had climbed. The mother bear finally pulled the cub out of the tree, and, after boxing its ears, chased

the naughty youngster back into the forest.

"The farmer remained in the tree-top for a long time because he was afraid that the she-bear would return and try to attack him again. However, this did not happen and the prisoner finally came down and fled home."

You will find many such cases in natural history books but not all of them with such a happy ending. The attack of the bear is carried out at high speed, but it is not true that the animal approaches on its hind legs to the attack. On the contrary, the bear bites its victim and knocks him down with a blow from its gigantic paw. A single blow from a bear's armed forepaw is enough to kill a man. What usually happens is that the bear knocks the man down and then runs away because, like any other wild animal, it is naturally afraid of human beings. As a general rule, if one encounters a bear, a word or a movement is usually enough to make it run away. In fact, few people ever meet a bear, and when they do it is usually by accident. Even gamekeepers and woodcutters, who spend their lives in the mountains, seldom see a bear during their whole life.

American Black Bear

The bear is guided mainly by its sense of smell, so it is usually warned well in advance about the approach of a man and immediately avoids him. If the wind is blowing from the bear towards the man, the bear receives no warning, so if the man remains motionless he may see the bear without himself being seen. The bear's eyesight is very weak, so it is unable to recognise a man until he moves. In every case where a bear has attacked a man, the animal was either being hunted or the man came suddenly upon a she-bear leading cubs.

The brown bear breeds readily in captivity, but the cubs usually present a problem. As often as not the zoo does not need them, and the cubs cannot be turned loose because bears raised in captivity are not afraid of man and are, therefore, dangerous in the wild. All old bears, even the tamest, become surly, and the slightest annoyance will provoke them into attacking a man without warning. It is because of this, and the bear's poker face, that animals in circuses are muzzled. But in spite of all these things and in spite of being more dangerous in captivity than the tiger or the lion, the bear is still one of the most popular inmates of zoological gardens.

Wild bears do no harm at all to man and, therefore, ought to be protected by law. We certainly do not wish succeeding generations to have to go to a museum in order to see a bear.

The **American Black Bear** is the nearest relative of the brown bear. It is sometimes known by its Indian name, *muskva*.

It is a smaller animal than the brown bear measuring about 5 feet long and standing 3 feet tall at the shoulder. Its coat differs from the brown bear's in being shiny-black, becoming light-yellow on the muzzle and forehead. In its general habits it resembles the brown bear. This species is found only in North America.

The **Himalayan Black Bear** is another black species, commonly seen in zoos. It inhabits the tropical regions of India, but is found in the Himalayas at great heights. It, too, is smaller than the brown bear and only the very largest males of the species ever reach the size of a female brown bear. The Himalayan Black bear can be recognised by the white V-shaped marking on its chest.

In its general habits the Himalayan black bear resembles the others. It is omnivorous but mostly vegetarian, and if prefers honey to all other delicacies. It will climb to the top of a tree or uproot an old tree trunk to reach a bee's nest. It is easily tamed and thrives in captivity.

Himalayan Black Bear

The **Malayan,** or **Sun Bear,** is the smallest species. It stands about $27\frac{1}{2}$ inches tall and measures over 4 feet in length. It has a golden-yellow muzzle and an orange-yellow spot on its chest. The fur over the rest of its body is black and short.

This species inhabits the Indo-Malayan tropics. It is mainly vegetarian and feeds on palm shoots and sweet fruits. Being a good climber it can cause a great deal of damage if it finds its way into a plantation. Many bears of this species are kept in captivity, but so far none of them has bred. While it is young, the Malayan bear is quiet and playful, but older animals are unpredictable and will make violent attacks on their keeper for no apparent reason. Although it is not a big bear it can cause serious injury with its powerful claws and strong teeth.

Malayan Bear

Spectacled Bear

The **Spectacled Bear** inhabits the Andes mountains of South America, and is a small species not unlike the Malayan. It derives its name from the markings on its head and face — a white stripe running from the snout to the eyes and another running under the eyes across both cheeks to the throat and chest. But the white pattern of the head is very variable and is sometimes absent altogether.

The **Sloth Bear** is of great interest because it looks like a sloth and was once classified as one. It has long, black fur, and its long, extendable lips look as though they were made of rubber. It feeds on sweet fruit juices which it obtains by gathering the fruit in its lips and sucking. In addition to fruit juices the sloth bear eats the eggs and larvae of ants, which it obtains by tearing open ant-hills with its long claws.

Sloth Bear

This species differs from other bears in having relatively small teeth and lacking the two central incisors in its upper jaw.

In India and Ceylon, the sloth bear is considered a most dangerous beast of prey and this is borne out statistically by the register of deaths in these countries. It appears that forest workers usually overlook the sloth bear where it lies hidden in the undergrowth. It is a very sound sleeper and is trodden upon before it awakens. The bear immediately attacks in self defence. Anyone who has seen the strong claws of the sloth bear will realise how easily this apparently defenceless animal could kill a man.

The **Polar Bear** is one of the giants of the family, measuring over 8 feet in length. Animals of nearly 10 feet in length have been recorded. Weight averages over 7 hundredweights, but old males weigh up to 10 and, sometimes, even 15 hundredweights.

As its name indicates, the polar bear inhabits the polar regions of permanent snow and ice. It is most numerous to-day in Greenland, on the North American Coast and in North Asia, but its numbers are steadily diminishing. In many places it has already been completely exterminated, while in others it survives only as the result of strict protection.

The polar bear is a nomad, inhabiting the inhospitable Arctic shores and the drifting pack ice. It has to change ground constantly in its search for food. It is at once the least settled and the most carni-

vorous of the bears. In its constant wandering it walks with a slow, shambling gait, swinging its head from side to side. At this pace it will cover many miles in a day without rest. Exceptionally, it will break into a run, but it soon tires. Hunters chase it with dogs knowing that the bear will drop with exhaustion after a few miles. Nevertheless, it is agile enough to climb steep icebergs and can leap across crevasses more than twelve feet wide.

The popular idea of the polar bear is of a tireless swimmer in the stormy northern seas, but recent research has shown that it is really an indifferent, if persevering swimmer, and can easily be overtaken by a man in a rowing boat. It is not really at home in the water and a hunter using a long pole can push it in any direction he wishes it to go.

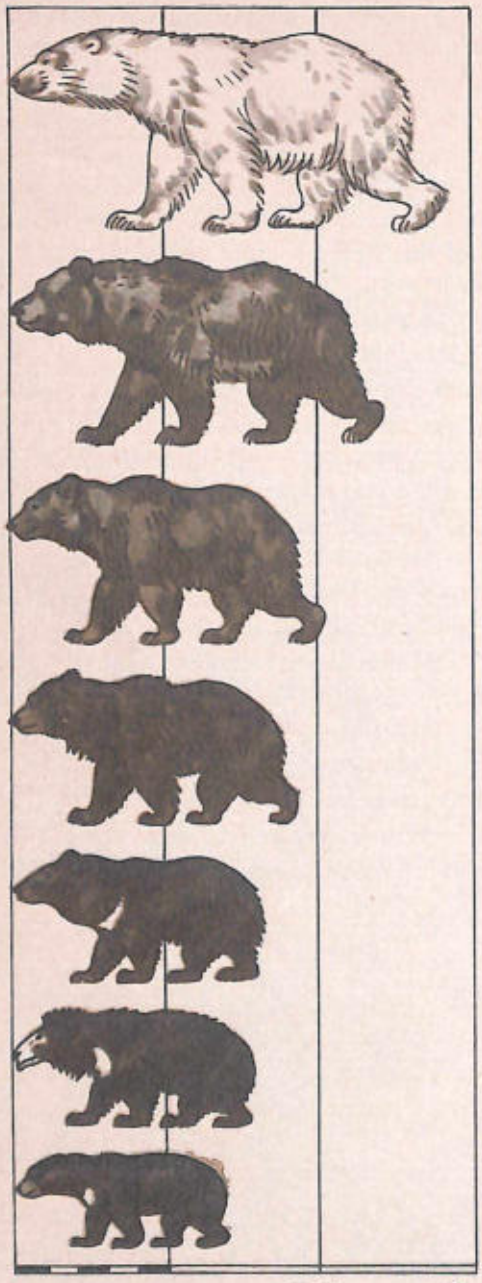
The diving abilities of this bear have also been exaggerated — the usual depth being $1\frac{1}{2}$ feet and seldom more than 6 feet. It cannot stay submerged for longer than two minutes. None of this means that the polar bear is a bad swimmer, merely that it is a true land mammal. Compared with aquatic mammals like otters and seals, the polar bear's body is poorly adapted for swimming.

The polar bear's most perfectly developed sense is that of smell, which, according to Arctic research workers, is better than that of the Eskimo dogs. Eyesight and hearing are relatively less acute and the brain is poorly developed. Indeed the polar bear's brain is smaller than that of any of its relatives, in relation to body size. The Norwegian research worker, Alwin Pedersen, writes:

"My numerous observations of polar bears, and they number not less than two hundred, have given me the impression that the animals wish for nothing more than to be left alone to hunt seals and other food. They seem incapable of realising that man is dangerous."

The main diet of the polar bear is seals, and it follows their movements round the year. As the wolves follow the herds of migrating caribou, so the polar bear has to move with the seals when they change their stations. Young seals are the commonest victims. In the

Polar Bear



The relative sizes of bears: Polar Bear, Grizzly Bear, European Brown Bear, American Black Bear, Himalayan Black Bear, Sloth Bear, Malayan Bear

early days of their lives, the young seals are hidden in cavities under the snow, close to the holes in the ice used by their mothers. The polar bear scents the young seals under the snow, digs them out and kills them. Quite often it will lie in wait beside a breathing hole and kill the old seals as they emerge. At other times, it will stalk seals on the open ice. It seems hardly credible that such a big animal is able to approach resting seals unnoticed, but the bear is greatly helped by the colour of its fur which matches its surroundings. Only the bear's black snout is visible against the snow. The bear stalks up with its muzzle pointing to the ground, making expert use of the broken terrain. Sometimes it approaches its prey from the sea, making a final rush after launching out on to the ice.

The polar bear kills its prey by a mighty blow of its paw. It is quite incapable of catching a seal in the water. On the contrary, the seals pursue the bear in the water, biting at its hind legs and buttocks. Unable to match their swimming and diving abilities, the bear makes little effort to defend itself and is usually content to retreat towards the shore as fast as it can. Besides seals, the remains of which it leaves for the Arctic foxes, the polar bear takes fish cast up by the sea. During the summer months it will eat berries, lichens and mosses. When hard pressed by hunger it will eat a variety of carrion, including walruses and stranded whales. Only in extremity will it attack man, and this seldom happens.

We have to make a distinction between the bear that intends to attack a man and the one that is attracted by curiosity. The polar bear inspects everything that is new, and just like a dog it will follow people for many miles. Bear hunters

exploit this curiosity, luring the bear into ambush by making conspicuous movements, or exhibiting strange objects.

If a starving bear takes to hunting man, it stalks up behind him just as it does when stalking a seal, making use of floes and other cover during its approach, then waiting for an opportune moment to attack. Nevertheless, according to the unanimous verdict of polar research workers, out of one hundred cases where a bear stalked close to a man, only one could be seriously considered as an intended attack. But attacks do take place and there is an account of one in the log-book of the Second German Expedition to the North Pole, when the astronomer, Borgen, was attacked:

"I was about fifty yards from the ship and, while it was still dusk, was busy examining my instruments. Suddenly, a bear attacked me and began to drag me away. The attack was so quick and unexpected that I was unable afterwards to explain what had happened. The bear had knocked me down with its paw. The blow it dealt me on the hips I could not feel at all, but I experienced pain when it started to bite through the skin of my head. As it does with seals, it was trying to bite through my skull, but its teeth were slipping. I cried for help. This scared the bear for a moment, but it returned and bit me several times on the head. When the captain heard my cries he called the crew together and they rushed to my help. The noise again frightened the bear and it began to run away, dragging me by the head. I kept hitting it on the ribs in an attempt to make it loosen its grip, but only after a gun-shot did it let me go. It then gripped me by the hand, on which, fortunately, I had a leather glove. After it had dragged me another three hundred yards, it finally let me go. Immediately afterwards, Koldeway was leaning over me with the words: 'Thank God. He is still alive.' The bear was standing a few paces away, evidently deliberating what to do next, but a bullet convinced it that it was time to go."

The polar bear was at one time much hunted for its beautiful coat, meat and fat. Man, however, is not its only enemy. On land, it has no enemies apart from man, but in the sea it has two. One of these is the walrus and an old male walrus can disembowel a polar bear with its tusks. The second enemy is the voracious Killer Whale.

Although it thrives in captivity, the polar bear has been bred only recently in zoos. So little was known about its life in the wild state that keepers tended to think it required to be kept cold. Modern research has shown that bear cubs in fact are highly sensitive to cold and need a temperature of about 18°C. Polar she-bears in the wild state give birth to their cubs in special dens dug in the snow, which are similar to the Eskimo igloo. The walls of the den are turned to ice by the warm breath of the bear, so that the heat is kept within. Snow accumulating at the entrance prevents warmth from escaping by that route. The newly-born cubs are very small and the mother holds them inside her fur with her paw. Like the brown bear, the polar bear sleeps through the worst of the Arctic winter in her snow den.

Nowadays, polar bear cubs can be successfully reared in warm boxes. The old belief that the adults needed seal fat before they could breed has been proved wrong.

ORDER: PINNIPEDIA

Pinnipedia are beasts of prey adapted to life in the water, but this adaptation took place long ago and separated them from the ancestors of the carnivora.

The torpedo-like body of these animals is perfectly designed for cutting through water. The shoulder and forearm are much shorter, while the extremities of the limbs have become elongated into flippers. The bones are extremely strong to withstand the pressure of water.

Pinnipedia, diving to great depths, come very slowly to the surface of the water. This is purely instinctive behaviour which guards against what is known as "diver's sickness" in human beings. Sudden emergence from a great depth causes the release of gases in the blood, just like the opening of a bottle of soda water. These bubbles in the blood would block up tiny capilliary tubes and cause serious disturbance to the circulation of the blood. That is why divers, like the Pinnipedia, must emerge slowly to adjust to changing pressure.

Members of this family have a thick layer of subcutaneous fat which is an excellent protection against cold and pressure. The fat is very elastic and protects organs from being damaged by excessive pressure. The fur is also adapted to this underwater life, being short, shiny and, at the same time, soft. Only the walrus is almost hairless.

The Pinnipedia feed mainly on fish. Their teeth are sharp and conical and even the molars have sharp ridges. The individual teeth do not differ much from one another. The arrangement is also evident in other fish-eating mammals such as dolphins. With their sharp teeth, they can hold slippery fish firmly. The young of the Pinnipedia, with the exception of the Californian Sea Lion, have no milk teeth.

The best developed sense in the Pinnipedia is that of sight. Sense of smell is imperfect and, in any case, would be useless underwater. During diving, a special muscle closes the nostrils; another closes the ears. The sense of touch is well-developed and the long, strong vibrissae on the lower lip are highly sensitive.

The order of the Pinnipedia is divided into three families:

EARED SEALS
Family OTARIIDAE

The members of this family can be recognised at once by their external ears, which are absent in all other Pinnipedes. When moving on land, the Otariidae can put their hind legs underneath their bodies and rotate them forward when moving on dry land.

Steller's Sea-lion is one of the largest members of this family. Bulls reach a length of over 9 feet and weigh about 12 hundredweights, but much larger animals have been recorded weighing one ton and over. Cows are much smaller and weigh about 2 hundredweights. The rough fur of this sea-lion is yellowish-brown, but appears black when wet. The young are completely black.

This species is found along the shores of the Pacific Ocean, from British Columbia, through Alaska to the islands of the Bering Sea, and along the coast of East Asia and Japan to Sachalin Island. Outside the breeding season, Steller's sea-lion is a wanderer. During the mating season, the animals come ashore to breed on rocks used by the species for this purpose since time immemorial. These breeding stations are known as rookeries and when the season is at its height, the barking of the bulls can be heard a long way off.

The bulls are the first to arrive at the breeding stations where they fight fiercely with each other for territories. Each bull defends an area of about 600 square yards. The cows arrive later and join the bulls already in possession of territory. The strongest bulls will hold a harem of up to eighty cows. Less powerful animals will hold only seven or eight cows. Some bulls have only one. About one quarter of the bulls, the youngest and the weakest animals, hold no cows at all and join the young sea-lions that arrive at the station with the cows.

A master bull has to guard his harem carefully and constantly. He drives away intruding bulls, and herds his cows away from the sea. Soon after arrival, the cows give birth to their calves and then the mating season begins. During this period, the master bull treats his cows very gently, which is in contrast to the aggressiveness he displays towards intruding bulls. Some bulls will even carry their cows in their teeth. During the mating period, the master bulls do not sleep or eat. All their time is occupied guarding territory. It is not surprising, therefore, that after the mating period they are totally exhausted. Even their voices change from a gruff, powerful bark to a hoarse grunt. This is to be expected since they do nothing but bark during the weeks of the mating period.

After the mating season, cows and cubs are the first to leave the station. Later they are joined by the bulls which are now concerned mainly with eating. Steller's sea-lions feed mainly on fish and cuttlefish. There is no species of fish that they cannot hunt down and overtake in the water.

Although it is such an excellent swimmer, Steller's sea-lion can become exhausted during storms at sea and animals sometimes drown. When a storm blows up, the sea-lions move shorewards and haul out on the rocks until the bad weather has blown over.

Man is the only serious enemy of this sea-lion and before the Second World War, between 12,000 and 20,000 animals were killed annually. Old bulls are killed with pistols, cows and calves are beaten to death with clubs. Much has already been written about the cruelty involved

Steller's Sea-lion

Californian Sea-lion

in killing these defenceless animals, but, unfortunately, it still goes on even although decent people condemn it. It has to be admitted, however, that in some parts of the world people have to earn their livelihood by hunting sea-lions.

The **Californian Sea-lion** is the species most familiar in captivity and can be seen in almost any zoo or circus. It is only half the size of Steller's Sea-lion and the difference in size between bulls and cows is not so pronounced.

This species inhabits the Pacific coast of North America and is found farther south than Steller's sea-lion. Sometimes it drifts with the currents as far south as San Francisco.

The fur of the Californian sea-lion is yellowish-brown when dry, and dark-brown when wet. In the wild state, it does not differ greatly from Steller's sea-lion in general habits. It is one of the most popular animals in captivity, being easily tamed and quick to learn the most varied juggling tricks. It can balance almost anything on its nose. This is a characteristic of the wild animals which often play with dead fish or stones in the same way, tossing them into the air and catching them on the tip of the snout.

Captive Californian sea-lions must be fed on sea fish and will consume from 9 to 13 pounds each day. If well looked after, they can live for about fifteen years. This species breeds readily in captivity.

Sea-lion

The **Sea-lion** inhabits the cool southern seas south of the River Plate, round Cape Horn and up to Peru, where it assembles on the islands. This is a large species. The bulls measure up to 9 feet in length and have long hair on their back resembling a mane. It has been said that this species is the least terrestrial of all the sea-lions and that it hauls out only during the short mating and breeding season. The same breeding stations are used by generation after generation.

The species mentioned hitherto belong to the group of sea-lions without under-fur. The fur of this group is not so valuable as that of sea-lions with under-fur.

One of the latter group is the **Alaskan Fur Seal.** This species is highly valued by the fur industry because it supplies most of the well-known seal skins. Its under-fur

is very thick. A fully-grown bull will measure up to $6^1/_2$ feet in length and weigh under 5 hundredweight. Cows measure up to 6 feet in length and are much lighter in weight.

This fur seal, sometimes known as the Sea-bear, inhabits the coast of North America as far south as 34° and its main breeding station is the Pribilov Islands. Related species are found on the northern part of the Pacific Ocean, north to North Japan. The skins of the Russian Commander Island seals are known to the trade as Copper-island seal, while the Pribilov furs are known as Alaska seal. Towards the end of the last century, Alaskan seals of all races had decreased dangerously in numbers. The International Agreement of 1911 saved the species and they are now in no danger. The United States Government controls the sealing on the Pribilov Islands, where about 50,000 are killed yearly out of a population of over 1,500,000. Bachelor seals are killed at these breeding stations and it is now illegal to kill fur seals at sea. Since 1911, the seals on the Russian Commander Islands have increased tenfold.

The Russian zoologist, Marakov, has written of the fur seals in that part of the world as follows:

"During the mating season, from May to December, they gather in herds of many thousands at their regular breeding stations. In winter, they migrate many thousands of miles to the Japanese islands, but they do not go ashore there. Bulls are polygamous during the breeding season and gather large harems. The bulls are from 88 to 132 pounds. They are sexually mature in their sixth or seventh year. Bulls from two to four years of age are hunted.

Alaskan Fur Seal

"The physiology of these animals, especially that of the bulls, is very interesting and little known. They remain on their breeding station for two months, or longer, without entering the water or eating. In spite of this, they are most active, spending much of their time brawling with neighbouring bulls, fighting for cows, mating, or defending their harems."

GREY SEAL, COMMON SEAL, ETC.

Family PHOCIDAE

This family of seals has no external ears and they are better adapted than the Otariidae for life in the water. The hind flippers point backwards, even when the animals are ashore, and are therefore useless as an aid to covering ground. The animals have to drag

themselves along by wriggles and jumps. The legs of the Phocidae are covered with hair and the toes have claws.

Seals spend the greater part of their lives in the water and are such masters of their element that they can swim in any position. While swimming they can perform complete rolls and leap forward with their whole body clear of the water. They will travel as far as 30 miles from the shore, but, like the sea-lions, retreat landwards before an approaching storm. They sleep in the water with their bodies in a vertical position. Once in a while, the seal breaks the surface with its nostrils to breathe in, then it sinks slowly under water to continue its sleep.

Ashore, the seal is less nimble than the sea-lion. It cannot walk and progresses by stretching and contracting its body. On slippery snow or ice, it can slide faster than a man can run. The whole body is very elastic and the seal can turn its head in all directions. This bodily elasticity enables the seal to leap out of the water.

Unlike sea-lions, seals are found mainly in the Northern Hemisphere. They live not only in the sea but also in land-locked lakes such as Lake Baikal, the Caspian Sea and Lake Ladoga. They are common in cold seas and can keep warm in the coldest winter. Their thick layer of fat protects them against the cold, because it prevents any surplus radiation of body heat. Because of this, the snow never melts under a resting seal. In winter, when the sea freezes, the seals keep ice-holes open. They use these openings as breathing holes and for gaining access to the shore. They keep their pups close to these breathing holes.

In seals there is delayed implantation, a phenomonon we have already discussed when dealing with the weasels. The gestation period for seals lasts for a year and one young is usual at a birth. Two are rare. The cows suckle their pups for a very short period, in some cases for a few days, and in others for three to six weeks at most.

Seals have a hoarse bark. They snuffle and whine only when they are enraged.

They have many enemies. In the water they are threatened by the killer whale, sharks and walruses. Ashore, they are preyed upon by the polar bear, but their most dangerous and consistent enemy is man. Hunters outflank them and then beat them to death with clubs. The most accomplished seal hunters are the inhabitants of Greenland. The zoologist, Fabricius, has described a Greenland seal hunt as follows:

"The Greenland seal hunters are such masters at handling boats that they can move about quite silently in the water. When a seal appears in front of them they observe it very carefully to see how it behaves and consider how best to catch it. If it is quiet, they try to make a close approach to harpoon it. This all happens without any noise, but of course it requires great experience and dexterity. Some hunters are able to approach within a few yards. If the seal has its head out of the water and is looking around, the hunter lies flat on the bottom of the boat. The seal ignores the inanimate object floating on the water. When the hunter is close enough to the seal, he throws his harpoon and quickly uncoils the rope, on the end of which there is a bladder.

"If the hunter does not throw the rope out of the boat quickly enough, the seal will tow him away and there is a danger that the boat will be overturned, drowning the hunter. The bladder at the end of the rope indicates the seal's position and hinders its swimming. This makes it easier for the hunter to kill the tired animal."

The hunting of single seals would not be a great threat to their numbers. Much worse is the uncontrolled slaughter of seals *en masse* carried on by sailors and professional sealers. Because of this inhuman practice, seals are becoming ever scarcer on the European coast. In Great Britain, the grey seal is protected by law and there is a controlled cull at only two breeding stations. This cull is entirely of pups.

Seals are killed mainly for their skin, fat and meat, but the meat is not very appetising. Greenland sailors make clothes and boots from the sealskins, while the bones are used to make shovels, nails and other utensils.

The **Common Seal,** or **Harbour Seal,** is one of the best known species. It measures up to 6 feet in length, the bulls averaging $2^1/_4$ hundredweights and the cows 2 hundredweights in weight. The fur is greyish-yellow in colour, blotched with black or brown. This species inhabits the North Atlantic and Pacific coasts, and is common round the coasts of Great Britain. In North Germany it lives in natural reservations. Younger seals often lose their way in great river estuaries and swim against the current; thus, for example, a young common seal was caught in the River Elbe, near the Czechoslovakian border, 470 miles from the sea.

The seal remains on its home stretch of coast and moves only within a radius of 5 to 10 miles. It prefers to haul out on sandy and clayey shores. Being diurnal in habits, it can be observed hunting and playing in daylight. It feeds mainly on plaice, but hunts also various crustaceans and molluscs. In the Wash area of England, common seals have been recorded feeding on dabs, flounders, whitings and a variety of shellfish.

The mating season begins in August, but there is some variation over its range. In the Wash area, mating has been observed from the end of July, and in the Shetland Islands it has been observed into the first week of October. Implantation takes place some time between the beginning of November and the end of December and the pups are born in June and July of the following year. One pup is usual and in cases of twins one usually dies. The mother feeds the one and ignores the other. In reservations, however, attendants keep watch on the young seals and collect the deserted pup, which is then reared on a bottle.

Although the bulls display aggressively towards each other in the breeding season and sometimes fight, they never at any time cause serious injury. There is no territorial behaviour because common seals do not assemble ashore to breed. The young animals are born either in the

Common Seal and Harp Seal

Baikal Seal

water or on some rock or sandbank from which they can float away on the first tide. Young common seals are active immediately after birth and can swim and dive, although they are not able to haul out on to rocks for a few days.

Seal pups are relatively large when born and the young common seal is a good example. At birth a pup will weigh from 20 to over 30 pounds, and measure from $31\frac{1}{4}$ to $35\frac{1}{4}$ inches in length, which is half the length of its mother. The pups resemble the adults in colour. Most of them shed their white coat before birth, but some retain a few white hairs and a few are born white. White pups change to adult colour within a few days.

The cow seal does not eat during the first few days of her pup's life. As soon as it is weaned, she leaves it and it must thereafter take care of itself, learning by experience how to catch prey and eat it underwater. It is not easy to catch a fish and swallow it underwater without swallowing a lot of water as well; that is why the young seals swim to the surface with their prey and stick their heads out of the water before swallowing it.

Common seals reach maturity in their third year. In zoos, they have been recorded living up to twenty years.

Caspian Seal

The **Baikal Seal** is somewhat smaller than the common seal. Its coat is olive-yellow or brown, blotched with dark circles. This species inhabits the coasts of Northern Europe, Asia, North America, the Arctic and the shores of Lakes Ladoga and Saimaa. The young are born with a shaggy coat which they shed twenty days later.

Two other species of seals are found in the Asiatic lakes. They are the **Caspian Seal** and the **Siberian Seal.** The former is found in the Caspian Sea and the latter in Lake Baikal.

The **Leopard Seal** is a large Antarctic species inhabiting the coasts of Antarctica, Patagonia, the Falkland Islands, New Zealand, Southern Australia and Tasmania. It attains a length of up to 12 feet and the females are larger than the males, a characteristic found in no other seal.

As its name suggests, this is a rapacious species and a fast swimmer. It lives largely on penguins but also hunts smaller seals. The leopard seal will leap clear of the water and crash-land on the drift ice when hunting penguins. As soon as the penguins catch sight of the enemy they

race shorewards, leaping high out of the water like fish, but in vain. The leopard seal leaps after them at high speed and many penguins fall victim to its sharp teeth. This seal is the main predator on the penguins.

Hooded seals are a special sub-group, notable for their facial adornments.

The **Hooded Seal,** or **Bladder-nose,** is the largest seal of the Northern Hemisphere. Bulls measure up to 8 feet and the cows up to $6^1/_2$ feet in length. This species is brown with dark spots on its upper side, and greyish with no spotting on its underside. Bull hooded seals have a kind of leathery pouch from nose to crown. This bladder is about 10 inches long and can be inflated to a height of 8 inches when the bull is excited. He inflates the bladder by breathing into it. Young bulls reach the age of four years before this bladder develops.

Like all other seals, the hooded seal feeds mainly on fish, but it also eats crustaceans and cuttlefish. Not much is known about its habits, except that it wanders for most of the year and settles only during the brief breeding season.

The bulls will display aggressively towards hunters, inflating their bladders and emitting whimpering sounds. On shore they are quite defenceless, but in the sea they will attack even a boat. Greenland hunters kill two or three thousand hooded seals each year.

The **Southern Sea-elephant,** or **Elephant Seal,** is a real giant and the biggest living species. Old bulls measure up to 21 feet in length and weigh over $3^3/_4$ tons. Cows, on the other hand, attain a maximum length of 10 feet.

Formerly this species was quite numerous in the South Atlantic, the South Pacific, and the coasts of Antarctica, but to-day it is dying out. It is found in greatest numbers on Kerguelen Island, where it is protected, but is scarce in other parts of its range.

Leopard Seal

In spite of its great size, the elephant-seal is not aggressive towards man, nor does it try to avoid him. Sealers used to ride elephant seals like horses and stick knives into them to make them move faster. Many such descriptions can be found in numerous travel books on the Antarctic. It is curious how people are always ready to boast about how they can kill defenceless and trusting animals for no reason at all. Here is what Coreal has written about the elephant seal:

"About noon, I went ashore with forty men. We encircled the elephant-seals and within half an hour had killed four hundred of them. Mortimer's men killed

Hooded Seal

about twelve hundred elephant-seals within eighty days."

This is the kind of senseless cruelty with which people often treat animals. There is no economic profit from the meat of the elephant-seal; only its skin and fat are used. One elephant-seal yields up to 187 gallons of fat. But this is no reason for exterminating arch an interesting animal.

Mature bull elephant-seals have a kind of trunk. This proboscis is usually $7^3/_4$ inches long, but it can be elongated to twice that length. If the seal is excited it starts moving this proboscis with the help of special muscles, and inflates it by exhaling into it in the same way as the hooded seal breathes into its bladder.

Ashore, the elephant-seal is quite helpless; but it is a perfect swimmer and sealers often come upon it twenty miles out at sea. On land, it is able to move only by bending and stretching its body. Being very fat, it trembles at every step as though its body were made of jelly. It has the most elastic and pliable spine found in mammals. In zoos, the keepers often place fish on the hind part of the elephant-seal's back to amuse the visitors. The seal folds up quite easily and catches the fish without any difficulty.

This giant species eats enormous quantities of food. In captivity, it requires 130 pounds of herring daily, but in the wild it feeds mostly on cuttlefish. At least, no remnants of fish have ever been found in its stomach.

Elephant-seals are solitary and live alone for most of the year. Twice each year, they assemble in large communities — in the breeding season and in the moulting season.

During the mating season, which begins in August, the cows are the first to swim to the islands: the bulls arrive later and furious fighting begins for the females. Fighting is severe and the animals scar each other on the trunks and heads with

Southern Sea-elephant

their sharp teeth. When a bull has collected a harem of several cows he guards them very carefully, and does not even allow them into the water. The bull does not eat throughout this period and at the end is emaciated and exhausted. The cow gives birth to her young and mates immediately afterwards. The young are up to 39 inches in length and covered with black fur. They grow quickly, and at the age of one month reach a length of 5 feet. The cow nurses her young for five or six weeks and then leaves it to fend for itself.

The elephant-seals assemble for the second time during the moulting period which is in January and February. At this assembly, the sexes remain apart. During the moult, the seals cannot enter the water, so they have to go hungry all the time. The surface skin peels off with the old hair in great ragged pieces, and the new fur starts growing in. During this time, the seals wallow in mudholes with only their heads showing. This is a very trying period for them. They become thin; their gums bleed; and their eyes cloud over. When the moulting period is over, the elephant-seals, clothed in their new fur, return to their real element — the sea.

The **Grey,** or **Atlantic Seal,** is found on the coasts of Northern Europe, Iceland, and Greenland. The world population of this species is now reckoned to be about 46,000 and about three-quarters of them are bred in British waters. All the British breeding stations, with the exception of one in Norfolk, are on islands or rocky coasts. The largest breeding colonies in Britain are on North Rona, the Orkney Islands and the Farne Islands.

The Grey seal has had a chequered history. The present population in British waters is about 35,000, yet fifty years ago the species was in danger of extinction. In 1914, it was given a close season by Act of Parliament. A further Act of Parliament in 1932 fixed the close season from 1st September to 31st December. There was much opposition to this extension of the close season. Now seals have to be controlled because of complaints of damage from salmon fishery interests. The damage is done to salmon nets and has been increasing steadily since the war. There is no suggestion that the seals are a menace to salmon stocks.

Because of the complaints of damage, there is now an annual cull of seal pups on the Farne and Orkney Islands. But this is an experimental cull — authorised for only a five year period — the aim being to reduce the seals of the Orkney and the Farne Islands to three-quarters of their present strength. The cull can be halted or varied in the light of experience.

There is much variation in the colour of this species. Bulls vary in colour from black or brown to pale-brown or grey, with light spots or patches. Females are light-grey or brown with dark spots. Bulls measure $8^1/_2$ feet in length, cows up to 6 feet. Young bulls resemble females in general appearance. The pups are yellowish-stained at birth, but their fur soon cleans to white. They begin to moult at the age of three weeks and at five weeks have dark coats. The pups weigh from 20 to 40 pounds at birth. The seal's milk is rich and the pups grow quickly, putting on weight at the rate of four pounds a day, so that at the end of a fortnight they weigh between 70 and 100 pounds. The pup has its adult teeth when it is a few days old. It sheds its baby teeth before it is born.

There is delayed implantation in this species. Mating takes place between September and December and implantation from mid-February to mid-April. The pups are born seven and a half months after implantation. Bulls are mature at the age of six years and cows breed in their fifth year.

WALRUS

Family ODOBENIDAE

The last family of the Pinnipedia could be described as transitional between the seals and the sea-lions. Like the seals, this family has no outer ears, but like the sea-lions they can place their hind legs underneath the body.

Next to the elephant-seal, the **Walrus** is the largest of the group. The bulls measure up to 15 feet in length and weigh over 19 hundredweights. Both sexes have ivory tusks which are really lengthened upper incisors. A peculiarity of the tusks is that they keep growing all the time, like the gnawing teeth of rodents. This is a singular phenomenon which does not occur in any other member of this group, or in any carnivore. The walrus's other teeth keep growing too, but are kept worn by use. The teeth of cows grow close together and are almost straight, but those of the bulls are spaced and curved.

The tusks are used for a variety of purposes but did not originate as offensive weapons as so many people think. The main diet of walruses consists of molluscs and crustaceans and the animals use their tusks for tearing these creatures from rocks and from the sea bottom. They kill bigger prey by embracing it with their front legs and crushing it. The tusks are used as weapons only by old bulls or by cows gathering young.

Many trustworthy Arctic explorers have testified that the walrus is capable of tearing open a polar bear's abdomen with its tusks. It has often been said that the animal attacks boats with its tusks, but in fact it uses them when trying to climb aboard to reach its human enemies. It also helps itself with its tusks when climbing steep icebergs. The fact that a walrus can pierce a boat with its tusks is no proof of attack.

Like other members of this great order, the walrus is hunted by man. However, a walrus hunt is quite dangerous, because the animal can defend itself capably and courageously. If hunters take a young animal away from its mother, the cow will attack fearlessly. A bull will attack man in defence of a threatened cow.

A report of a German Polar expedition, mentions an encounter with walruses:

"On the way to Clavering Island, we had to go on skis over fresh thin ice. On our way, we were suddenly frightened by walruses that broke the ice in front of us several times, sticking their heads out of the water. We started to run away, as any attempt to defend ourselves would have been in vain. The walruses, swimming under the ice, followed us. Their behaviour was as ridiculous as it was unpleasant. As we heard their grunting and snuffling, we were even less eager for their company. We scattered as fast as we could over the thick icy mud, looking for a safer place. All the time, the rattle of the

Walrus

ice as it was broken by these monsters kept pace with us. If the ice had been broken under any one of us, we would have been lost. In the end, a platform of old ice saved us from the pursuing walruses."

Adult walruses have thin fur. The fur of the young is thicker. The moult takes place in November and the new coat does not grow until March, so that during this period the animals are almost bare. The vibrissae on the upper lip are as strong as the quills of a hen and are nearly 12 inches long.

The walrus inhabits the Arctic seas, the coast of Siberia from the mouth of the Yenisey River to the islands of Novaya Zemlya and Spitsbergen, Greenland and the coast of Hudson Bay in North America. The animals do not like to leave the coast and if they have to undertake a long migration, for example during the winter, they swim close inshore. Nevertheless, some of them wander far from their home area and walruses have been killed in Denmark, the Netherlands, Norway and Scotland.

Walruses have not, as yet, been carefully studied. The bull usually has only one cow and a bull, cow and young appear to be firmly united as a family. The young animal is dependent on its mother for a long time and she feeds it for over two years.

In captivity, the walrus will live until a great age if properly cared for, but it needs great quantities of fresh fish. In its wild state, it prefers to feed on molluscs and it is also fond of fishes and young seals.

ORDER: CETACEA

We have been discussing many mammals whose main element is water, but they do not spend their whole life there. At some time or other, they have all to come to dry land. Originally, all mammals were land animals, but some of them became adapted to living in water. The Cetacea are the best adapted of all and it is not surprising that in most languages their names are derived from the word for "fish". In fact, the only thing the Cetacea have in common with fish is their environment. They can no more be classified as fish than bats can be classified as birds.

The calves of the Cetacea are born fully developed and suckle their mother's milk from the first, just like any other mammal. As the calf is surrounded by water when being suckled, it is unable to suck in the real sense of the term, so a special arrangement is necessary. The skin fold which surrounds the mother's nipple pushes up and closes round the calf's mouth. The fatty milk is then squirted into its mouth by the contraction of special muscles round the nipple. When suckling her young, the female lies on her side.

The whole structure of the Cetacea is adapted to life underwater and they can move freely through endless oceans. The largest creatures living to-day are among the Cetaceans. Compared with the Blue whale, which is nearly 100 feet long, even the elephant is a dwarf.

The massive body of the Cetacea is not divided into head, neck and trunk. In the skeleton we can easily recognise the vertebrae of the neck, the ribs, the lumbar and sacral regions, and the tail. The hind legs are vestigial and the pelvis rudimentary. The fore limbs have preserved their basic structure, even though they have developed into flippers.

The head of the Cetacea is disproportionately large and passes straight into the body. At the end of the body there is a horizontal tail fluke; fish have vertical tail flukes. The flippers function as steering rudders and have more finger joints than the forefeet of mammals. The Cetacea have a special sebaceous dorsal fin. The mouth is wide-cleft and lipless; the eyes are very small compared with the body size and are placed close to the corners of the mouth; the eyelids are immovable.

It is an interesting fact that the skull bones on the right and left sides are unequally developed. This is not noticeable on the body of the animal but the disproportion can be clearly observed on the bare skull of the skeleton. The right side is more strongly developed than the left. The right side of the tail fluke is also larger than the left so that the animal, when swimming, automatically steers to the left. The main means of propulsion is the tail fluke, which the animal mostly moves up and down. This movement is very important in diving and surfacing. It has often been said that the tail fluke of the Cetacea is also capable of performing revolving movements, like a ship's propeller, and photographs of dolphins certainly show a wake suggesting this.

The thorax of the Cetacea is elastic because of the special way in which the ribs are joined to the vertebrae, but this elasticity is often overestimated. The pressure of water on such a gigantic animal is great and should the thorax be too elastic the organs inside it would be crushed. The size of the lungs is small compared with the size of the animal.

The ability of the blood cells to hold large quantities of oxygen enables these giants to remain a long time underwater, up to one hour in some cases. In addition to this, the Cetacea have special valves within the blood vessels which can cut off supplies from some organs, thus preserving a greater quantity of oxygenated blood for more important ones such as the nerves. In addition, there is a network of fine capillary tubes whose function is to keep certain important organs well supplied with oxygenated blood.

The Cetacea can feed underwater. They produce only weak sounds that serve as a means of communication. They may also produce sounds inaudible to the human ear by which they can locate the position of prey. They have well-developed hearing organs, but they can detect sounds more or less through the surface of the body. The skin of the Cetacea, with a few exceptions, is bare.

The members of this order never leave the water and give birth to their young in it. The period of gestation is long, ten months in the smaller species, over a year in the larger ones. During the mating season, the bulls leap high above the surface of the water. Some species visit special places where the cows give birth to their calves and are not driven away even by the annual slaughter that often occurs in such places. Other species have permanent summering and wintering areas. These are, of course, always immense ocean areas, because the Cetacea are highly mobile. The summering and wintering areas are widely separated, but it has been shown that the animals use regular routes from one to the other. The discovery of such routes was economically important, for it enabled the whaling ships to follow the migrating animals. Whales are marked so that their movements can be studied and this has the same importance as the ringing of birds. The markers are shot into the skin of the whales.

Most members of the Cetacea have no clearly defined territory. Their movements depend on the temperature of the water and food supply. To a very great extent they prefer warm seas.

Under their skins the Cetacea have a layer of fat up to 18 inches thick, and all of them, especially the whales, have been hunted for this. Man has been hunting whales for the last thousand years. Whale-hunting has become a major industry and many species have been threatened with extermination.

Dr. Baum writes of a whale-hunt as follows:

"At a distance of about one quarter of a mile, a giant whale is surfacing at regular intervals. First of all we see the white water spout of its blow. This disappears and, presently, a great black body appears on the water. The whale's blow is not so neat as it used to appear in our school books. Actually it is a spout of uncertain outline and not very high. The blow is different in different species and an experienced hunter can tell from the shape which species he is looking at."

Whale blubber was the main booty of the sailors. As long as kerosene was unknown, whale oil was burned in lamps. When kerosene lamps became commonplace about one hundred years ago, the whaling industry became less important and the price of whale oil went down. But in modern times new uses have been discovered for this oil and the animals are now hunted more than ever. The old hand-thrown harpoon has long since been replaced by harpoon missiles fired from a three-inch gun. The point of the modern harpoon has a cast metal casing containing an explosive load which makes short work

of the whale. The dangerous business of whale-hunting has become one of easy slaughter, and floating factories sail the seas instead of the old-style whaling ships. Nowadays, everything is utilised and fertilisers are manufactured from the blubber and meat. Modern hunting methods have reduced whales to a dangerously low level and some species have been exterminated. There are continual protests about this slaughter and demands for protection are constantly made.

Some agreements have already been reached, but the regulations are not always respected and some states are greater offenders than others. New ways are always being sought to make whaling simpler and easier. Norwegian whaling companies are even beginning to use helicopters that operate in collaboration with a fleet of fast steamers. The helicopters search for the dwindling herds of whales and report their position by radio to the steamers. Experts have maintained that helicopters could also be used for killing the whales, but they would require special missiles that would inflate the bodies to keep them afloat.

There is every reason to suppose that whales will soon become extinct.

The Odontoceti have teeth but they are all alike and there is no distinction between incisors, canines and molars. Their teeth, therefore, are more like those of reptiles than mammals.

DOLPHINS
Family PLATANISTIDAE

This family has three genera living in fresh water. They inhabit the rivers and lakes of South America and Asia. Their head is clearly separated from the body and the neck vertebrae are not fused as in the majority of the Cetacea. They have long and narrow jaws with numerous teeth.

The **Susu,** or **Gangetic Dolphin,** inhabits such great Indian rivers as the Ganges, Brahmaputra and Indus. It measures from $6^1/_2$ to 10 feet in length and bears one young at birth. It feeds on fish and crustaceans.

Boutu

The **Boutu,** or **Amazonian Dolphin,** is as large as the previous species but has a round muzzle covered with rigid hair. Its colour is pale blue on the back and reddish-pink on the under-surface. The cow is about half the size of the bull. This species inhabits the Amazon River and its tributaries. The natives consider the boutu to be a river god and do not hunt it. They call it Bondo. Very little is known about its habits or breeding.

Other South American rivers are inhabited by fresh-water species of the genus Stenodelphia. As late as 1918, another

Asiatic species was discovered. This was the **Chinese River Dolphin,** discovered in the Tungting Lake on the Yangtze Kiang River.

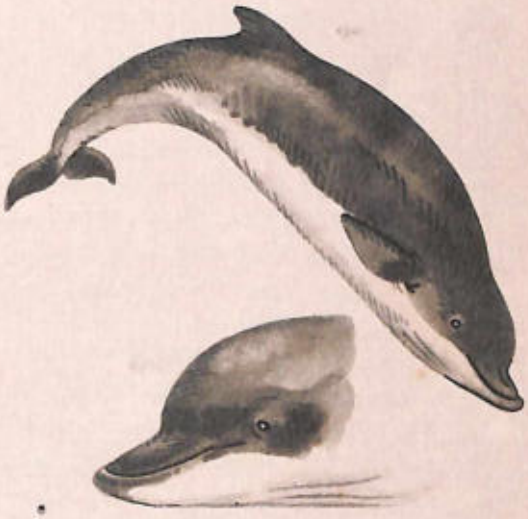
BEAKED WHALES
Family ZIPHIIDAE

This family includes several genera of big and small Cetaceans. Mature specimens have one or two pairs of teeth in the lower jaw but none in the upper jaw. The cows have smaller teeth than bulls.

Baird's Beaked Whale measures up to 40 feet in length and has two pairs of teeth. It inhabits the northern areas of the Pacific Ocean. It is black except for a white spot on the hind part of its abdomen. This species is of no importance to whaling because it is comparatively small and not very numerous.

The **Bottle-nose Whale,** called the **Beaked Anarnak** by the natives of Greenland, is a medium-sized species, measuring from 20 to over 30 feet in length. Its snout is 12 to 24 inches long. The forehead rises almost straight up from the mouth so that the anarnak has a characteristic profile. On the tip of its lower jaw it has two round teeth. The general colour is dark-grey, almost black. Old bulls are lighter shaded and old cows are grizzled. This species feeds mainly on squids and dives to a depth of 650 feet. It can remain submerged for up to two hours.

The anarnak lives in the waters of the North Atlantic up to the White Sea, but is also found along the entire European seaboard as well as in the Mediterranean coast of France. It is widely hunted in the north. It feeds mainly on cuttlefish.



Bottle-nose Whale

SPERM-WHALES
Family PHYSETERIDAE

This family is recognisable at once by the large square head which looks sawn-off in front. The lower jaw is very narrow. In the upper jaw the teeth do not penetrate through the gums, but the lower jaw has a great number of narrow, cylindrical teeth,

all of the same shape and about 8 inches long. In the upper part of the skull, mature animals have a double cavity containing a special light oil known as spermaceti.

The **Pygmy Sperm-whale** is relatively small, being about 7 to $10^1/_2$ feet long. Its head is the typical box-like shape. The upper side is bluish-grey to dark-grey, the under surface pinkish. The lower jaw has eighteen to twenty sharp teeth pointing backwards. This species inhabits tropical seas but wanders widely. It is rare everywhere. Two specimens have been caught on the French coast and one off the Dutch coast, so that the pygmy sperm-whale can be counted as a European mammal. It avoids Arctic seas.

The **Sperm-whale** is more common and belongs to the giants of the group. A bull sperm-whale will measure from $42^1/_2$ to 65 feet long and a cow from $29^1/_2$ to 40 feet. Specimens over 65 feet are rare. A. G. Tomilin gives the dimensions of over 15,000 sperm-whales caught between 1929 and 1949 in the northern part of the Pacific Ocean. Out of this great number, only one was longer than 65 feet. There are great differences in bulk between bulls and cows. The circumference of the body of the bulls is 30 to 40 feet and the horizontal tail fluke is almost 16 feet wide.

There is much variation in the colour of sperm-whales. Basically they are dark on the upper parts and light underneath. Most of them are bluish, but some are black.

This species, like the pygmy, inhabits mainly tropical seas. It was once very numerous. Loesche tells us that the original habitat of the sperm-whale lay between 40°N and 40°S. Latitude. From there, some animals wandered far to the north or south and often reached the European coast and the Mediterranean. Modern zoologists have discovered that these errant animals are usually solitary unpaired bulls. Bulls of this species usually travel in company with a number of cows, like a harem, so all bulls cannot find a mate. A swarm of sperm-whales numbers from fifteen to twenty animals, although swarms of hundreds used to be quite common.

The swimming sperm-whale can be recognised at a distance by its "blow", which rises to a height of 15 to 50 feet and is inclined forward at an angle of about 45 degrees. It lasts for one or two seconds. The whale surfaces for ten to fifteen minutes then submerges shallowly several times before diving for a further twenty or thirty minutes. It can stay submerged for sixty to eighty minutes. It can stand great pressure and has been known to dive to a depth of half a mile.

When undisturbed the sperm-whale moves at a speed of 3 to 5 miles per hour, but when hunted it can travel at a speed of $13^1/_2$ miles per hour.

The sperm-whale feeds mainly on cuttlefish. Because it dives so deeply it has a great hunting area and is never short of food.

Soviet zoologists in the Far East have shown that the main diet of sperm-whales there is a small cuttlefish. One of these zoologists examined the stomachs of 1,572 sperm-whales and found that 81 per cent. contained cuttlefish and nothing else, 18.5 per cent. had a mixture of cuttlefish and fish, and only 0.5 per cent. had fish and nothing else. It is easy to discover how many cuttlefish the whale has eaten because the chitinous jaws of

the cuttlefish, which are similar to the beaks of birds, are not digested. Tomilin mentions that between 15,000 and 20,000 pairs of cuttlefish beaks have been found in the stomach of a whale. Fish are probably an accidental prey of this species.

Cow sperm-whales are not such wanderers as the bulls and keep to a more restricted area. Their range lies between 40°N latitude and 40°S latitude. Animals found in the Antarctic, North Atlantic and the Indian Oceans are usually bulls. The whales mate in warm seas and have their young there. Gestation lasts from ten to twelve months. The cow gives birth to her young at any season of the year and wherever she happens to be, but usually she looks for an area of clean, deep water in the lee of an island. Cows congregate near the Galapagos Islands, the Azores, the Bermudas, Madagascar and other suitable places.

The newly born sperm-whale measures from $11\frac{1}{4}$ to 13 feet in length and weighs one ton. It sucks its mother's milk by taking the nipple into the side of the mouth — although some zoologists say that it sucks in the normal way, which is with the front of the mouth.

The sperm-whale is one of the most hunted species. It is easily caught because it surfaces for long periods and can be located without difficulty. Tomilin says:

"The sperm-whale that is attacked or pursued does not change its course for five to seven hours. Therefore, the whaler follows the herd in a straight line. The sperm-whales always stick together.

"The slaughtered animals are left to float freely on the sea and the whaler continues to follow the fleeing herd. Our whalers have often succeeded in killing six bulls. On one expedition on 17th July, 1934, the whale ship *Avangard* discovered

Pygmy Sperm-whale

a herd of eighteen animals and killed six of them. She then radioed another ship which killed five more. Only seven whales escaped with the coming of dusk."

When whaling was at its peak the whalers slaughtered mainly sperm-whales so it is small wonder that their numbers have decreased in many parts of the world. According to the International Whaling statistics, more than 900,000 whales were killed between 1909 and 1947 and of this number 75,000 were sperm-whales. In Far Eastern waters they are still numerous, and there whole flotillas of modern Soviet whaling ships have been fishing since the Second World War.

Tomilin records that: "During the twenty-two years of whaling 51 per cent. of whales killed were sperm-whales. During the period of five years from 1933 to 1937 sperm-whales made up only 27 per cent. of the catch, but between 1950 and 1954 they made up 87 per cent."

Almost every part of the sperm-whale is used. Besides blubber it provides spermaceti. This is a colourless oil which fills the cavity of the skull. When exposed to the air it hardens into a substance similar to scaly wax. When the whale dives into the depths where pressure is great, the spermaceti, according to some zoologists, is very important for closing the blow-hole. Spermaceti is used in the manufacture of medicines and candles. Another valuable product of the sperm-whale is ambergris,

which is used in the perfume industry. This is a dark, wax-like substance found in the intestines of dead or sick whales. It is sometimes found floating on the sea or cast up on shore. There may be some connection between ambergris and the cuttlefish which are the sperm-whale's main diet, as the ambergris often contains the jaws of cuttlefish. In ancient times and in the Middle Ages, ambergris was credited with miraculous healing powers. Nowadays, it is used only in the manufacture of perfumes.

No one can feel happy about the present rate of slaughter of sperm-whales; and the killing of cows and calves at least should be prohibited by International agreement, otherwise the sperm-whale will follow the dreary road to extinction already travelled by so many mammal species.

WHITE WHALE AND NARWHAL
Family MONODONTIDAE

The whales in this group are small. Although they measure several yards in length, they are pygmies compared with the sperm-whale and other species. In these whales the dorsal fin is either rudimentary or absent. The flippers on the chest are short. There are few teeth and even these are lost with advancing age. The family has two genera.

The **Narwhal** usually measures from 13 to 18 feet in length. Exceptionally it reaches a length of over $19^1/_2$ feet. It weighs one ton. The cows are smaller than the bulls and never exceed $16^1/_4$ feet in length. The sexes differ in colour as well as size, the bulls being paler than the cows. Both have black spots on the back. Very young calves are an all over bluish colour.

The head of the narwhal is cylindrically rounded in front. Teeth develop only in the upper jaw — two incisors and one molar on each side. As the whale becomes old the molars fall out. Actually the narwhal does not need teeth because it lives on soft prey, mostly molluscs, which it does not have to bite. The left incisor continues to grow into a tusk several feet long with an anti-clockwise spiral.

The narwhal is easily recognised by this long, spear-like tooth which can reach half the body length. Sometimes there are two such teeth, but the right one rarely develops, although it may grow on and duplicate the left. Cows do not have these teeth.

This long tooth is used by bulls during the mating season as a weapon against rivals. That is why it so seldom remains undamaged. It shows the scars of old fights and the tip of a spear tooth has been found in the body of a narwhal.

The narwhal's range lies between 70° and 80° North latitude and it rarely appears in southern areas. It has, however, been found on the English coast, where there have been a few strandings, and once in the shallow waters of the Dutch coast.

All experts are agreed that narwhals are alert and swift animals. They usually swim in small companies of six to twenty, but herds numbering thousands of animals have been seen in the past. They dive to a depth of 1300 feet and can stay submerged for half an hour. When they surface their "blow" produces a whistling

sound that can be heard some distance away.

The narwhal is of little importance to whalers, only the blubber, skin and tooth being used. Decorative articles are still manufactured from the long tooth.

The **Beluga,** or **White Whale,** derives its name from its colour, which is white. Kukenthal believes that this white colouring is an adaptation to life in the Arctic seas, but young belugas are not white, they are dark grey. As they grow older they are, at first, spotted with brown; later they become whitish yellow.

Arctic waters, north of the Arctic Circle, are the habitat of this whale and it prefers areas close to river mouths. Sometimes the beluga will swim up big rivers and penetrate deep into the continent, but this is rare. Dall mentions that he killed one beluga 700 miles from the sea in the Yukon River of North America.

During the hard winter, when the Arctic seas are mostly frozen, the belugas wander southwards and are sometimes encountered far outside the usual southern limits of their range. The most southerly known point reached by a beluga is the coast of France. One was killed off the coast of Germany near the mouth of the river Elbe.

The beluga is about the same size as the narwhal and closely resembles a narwhal cow. The forehead is a vault-like curve; the mouth is somewhat elongated and beak-shaped. The head is separated from the body by a distinct neck, and this really distinguishes it from other whales whose heads are joined to the body without any sign of a neck. The beluga has teeth in its lower as well as its upper jaw, numbering from thirty-two to forty.

Single belugas are seldom encountered. They prefer to live in small or large herds. Commercial whalers do not waste time on belugas, but the natives of Greenland and North Asia are largely dependent on them and they usually catch the whales in strong nets. According to Vinogradov, the Greenland Eskimos killed 650 belugas between 1924 and 1934. It is an interesting fact that the belugas remember the places where they have been hunted and afterwards avoid them.

Kukenthal says that: "A herd of belugas that has once been caught in the nets and has escaped will thereafter avoid them and so are lost to the hunters. Herds of males, living apart from the cows and calves, are particularly wary."

Eskimos consume not only the fat and meat of the beluga, but also its skin, which tastes like the white of an egg. The skin is also tanned for the manufacture of very strong belts. Some tribes worship the belugas as holy animals and hang the skulls on long poles as sacrifices to the gods. The fat and meat, however, they eat themselves.

The mortal enemy of the beluga is the killer whale, or Grampus. Here is a description by the Danish observer Nielsen of killer whales attacking belugas:

"In the spring of 1922 I watched a herd of killer whales attacking belugas. The largest killer whale caught one of the belugas by the breast flipper and dived

White Whale

with it. The rest of the belugas were torn to pieces in a short while so that the surface of the sea was shiny with their fat. One of the floating belugas had its lower jaw torn off and a torn flipper was hanging only by a piece of skin. Of the other victims only pieces of skin came to the surface."

The belugas are also attacked by polar bears and polar sharks. Walruses are also said to attack them, but this seems most unlikely.

DOLPHINS

Family DELPHINIDAE

Most of the Cetacea belong to this family. They are rapacious animals with strong teeth in their upper and lower jaws. All the Dolphins are excellent swimmers, notable for their rythmical movements and their great leaps out of the water. Travellers aboard ship often amuse themselves for hours watching the accompanying dolphins. There is great variation in shape between species. Some have a narrow, elongated head, others a rounded head, and still others a angular head reminiscent of the sperm-whale. The majority feed on fish.

During the mating season the bulls fight with each other for the cows. The cow gives birth to one or two young after a gestation period of ten months. She feeds the calves for a very long time.

Recent research has revealed that dolphins are highly intelligent and it can now be said that their intelligence is sometimes of a higher order than that of chimpanzees, which had until now been considered the most intelligent of mammals. Much detailed work remains to be done on this subject, but the results obtained so far have been surprising.

Everything we know about the mental abilities of dolphins is the result of research by the American scientist John Lilley and his colleagues. Dr. Lilley has clearly demonstrated the dolphin's ability to learn, and proved that the animals are able to communicate their experiences to each other. The more experienced animal is in the real sense of the word a teacher of the less experienced. During his experiments Dr. Lilley made use of modern electrical instruments. It was discovered that when the instrument was placed on the body of a dolphin, so as to give it slight but agreeable electrical shocks, the animal quickly learned to connect and disconnect the circuit. The switch was so placed that the dolphin could switch it on or off by the pressure of its beak.

Dr. Lilley and his colleagues made many such experiments to demonstrate the dolphin's intelligence and its ability to learn. It has now been revealed that dolphins have a means of communication — a range of vocal utterances akin to human speech. In addition they are also able to communicate by means of echo-location, the phenomenon we have already discussed in the section on bats.

Individual sounds of dolphin language were recorded on tape and when these were played back the animals reacted according to the meaning of the individual sounds — warning, joy, fear, et cetera. A surprise was in store for the scientists when they began to study the sounds uttered by the dolphins. As they listened to the amplified sounds the

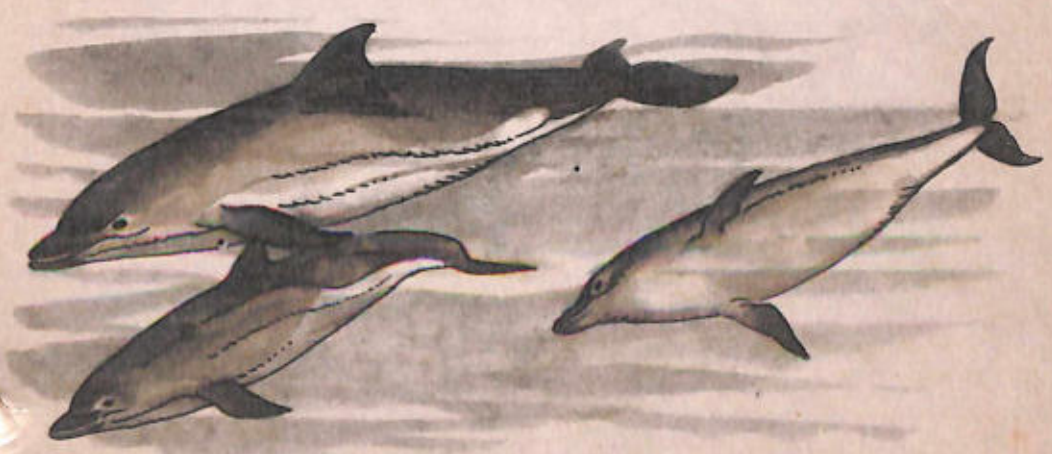
scientists were amazed to hear English words coming out of the loud-speaker. They were simple words which the scientists had used while talking to each other, and which the dolphins had learned. The dolphins, of course, did not use the words as speech. They were merely mimicking.

The experiments continued and the dolphins quickly learned a number of figures in English. These results show that the dolphin has an extraordinary ability to learn, but it would be rash at this stage to credit them with any reasoning ability, and it cannot be said that the sounds used by dolphins to communicate with each other constitute language in the real sense of the word. But other surprises may be in store.

Dolphins have long been noted for their ability to perform tricks, but Dr. Lilley's work has demonstrated that their abilities go far beyond this and the dolphin must now be considered the most intelligent of all mammals. The dolphins of the Oceanarium leap out of the water at a sign from their keeper, take titbits from his mouth, and play basket-ball.

The **Common Dolphin** is found in the Atlantic Ocean, Indian Ocean and the North Pacific. It occurs also on the Atlantic coast of Europe and in the Mediterranean and Black Seas, but it avoids the Arctic Seas. Dolphins always congregate in smaller or larger communities and travel at a speed of 22 miles per hour. The common dolphin feeds almost entirely on surface fish, far from the shore.

The common dolphin has to breathe at short intervals, so cannot remain underwater for long periods. Apart from its main diet of fish it will also eat cuttlefish and molluscs and other sea fauna. Sometimes it will even attack the young of its own and related species. It measures 58 to 85 feet in length and has a long, narrow mouth with forty to fifty and sometimes even sixty-seven teeth. Its basic colour is dark brown, almost black, with a greenish tinge on the upper parts. On its sides it has grey, yellowish-brown or white wavy bands.



Common Dolphin

The Black Sea dolphins are hunted in a variety of ways. The best results have been obtained by deep trawling with big nets, one mile in length and 260 feet in depth. Such gigantic trawling nets are towed by several ships. The animals thus caught are shot in the nets and it is said that dying dolphins utter wailing cries. Under the water they can communicate with each other by clear calls. They are hunted mainly for their meat and fat.

The **Bottle-nosed Dolphin** is a common species which is often found on the coast of Europe.

The **Killer Whale,** or **Grampus,** has a short snout and its head is rounded in front. Its large dorsal fin is conspicuous and triangular in shape. Bulls are 33 feet long and cows from 12 to 15 feet. The cows have larger dorsal fins than the bulls. The fins are well developed, their width being equal to one-sixth of the body length. The sharp dorsal fin of the killer whale often shows above the water when the animal is swimming. The upper surface of the head and body is black, the under surface and the spot above the eyes are white. There are twenty to twenty-six strong teeth in each jaw.

Bottle-nosed Dolphin

This species is found in all the oceans, but particularly in the Northern Hemisphere. It is often reported on the Atlantic coast of Europe. Exceptionally, it will wander upstream in great rivers.

Killer whales hunt in packs and they are among the most rapacious of animals. They can travel at a speed of 23 miles per hour. Everything that lives in the sea — whales, dolphins, seals and sea-lions — flees from them in terror. Whales and dolphins leap on to the shoals in despair and seals and sea-lions try to escape on to the rocks. Killer whales are not afraid of prey bigger than themselves. Scamon has described how they attack other whales:

"A whale attacked by these sea wolves reminds one of a hunted stag from which the wolves tear off chunks of meat. Some killer whales hang on to the skin of the victim; others make repeated attacks; some bite into the whale's lips, and if it opens its mouth they tear out its tongue. In the spring of 1958 I saw two killer whales attacking a whale and her calf. The calf was almost three times the size of its attackers and struggled with them for almost an hour. The enraged killers attacked the cow and her calf in turn. At last they killed the calf and its body sank out of sight. The cow was now exhausted. As soon as the calf had succumbed, the killers dived into the depths, tore off large pieces of meat and brought them to the surface to be swallowed there. While they were devouring their prey the frightened mother fled, leaving behind her a long trail of blood."

There is no limit to the rapacity of killer whales and they are not put off by the proximity of ships. A. N. Soljanik of the Russian whaling ship *Slava* says that he has often seen killer whales tearing out the tongues of dead whales that were being towed by the ships. After they bit off a mouthful they swam away to swallow it and returned again to the carcasses.

Although killer whales are not rare they are seldom hunted because they do not yield a great profit. In Far Eastern waters only one hundred and sixty-nine were killed in the ten years between 1935 and 1945. In 1953, the Japanese killed fifty-seven and the Norwegians about fifty, in the Barents Sea.

The **Pilot Whale** has a big round head, long narrow flippers and a large dorsal fin which is not as conspicuous as the killer whale's. The colour is usually black with grey stripes on the under surface. This species inhabits the Arctic Sea and the north regions of the Pacific and Atlantic oceans. It is also found in the vicinity of the Faeroes, Shetlands and the Orkneys and wanderers occasionally reach the Mediterranean. Pilot whales sometimes congregate into big herds led by an old bull, who is placidly followed by all the others.

Pilot whales are hunted in the far north and Professor Kunsky has given the following description of a hunt near the Faroes:

"Nobody would think of hunting two or three pilot whales that had detached themselves from the main herd. The hunt begins only when the entire herd has been sighted. When a herd is sighted the spotter hurries to the village shouting *Grindar*, which is the word for pilot whales. This hunting call alerts the whole community

Pilot Whale

and every man is obliged to take part in the hunt. The men hurry out with their harpoons, which are 8 feet long and consist of a broad, two-sided knife mounted on a long pole with a rope attached so that the harpooner can throw his weapon, extract it, and throw it again. Another weapon is a razor sharp knife. The men also carry armfuls of stones into the boats.

"The boats are launched and at a great distance from the herd the men position them in a wide circle. The circle closes in slowly until the boats are 50 yards apart, thus surrounding the herd. If the herd is large a great combined effort is necessary to hold it close together, and individual animals often escape. After the herd has been encircled it is driven before the boats into a fiord or up a river. The encircling boats press continuously, the hunters throwing stones in front of the whales to keep them on course.

"After all the stones have been thrown, the hunters bring another curious implement into action. This is a lump of lead, 10 inches long, attached to a rope. The hunters throw the lead into the water and pull it out, repeating the process over and over again. When the whales reach the end of the bay and hit the shoals they

realise their danger and all of them turn about. This is the decisive moment of the hunt. The hunters begin throwing their harpoons at animals some distance away to avoid the risk of wounded whales overturning the boats with their tails. There is now chaos in the water and in the boats. Harpoons are thrown with the speed of lightning, extracted, and thrown again and again into the whales' heads, bodies and tails. The wounded animals dive about wildly, and they leap and hit the water with their tail flippers; the foam boils and the wounded animals blow out clouds of white steam.

The whales now turn towards the shore. Men who can find no more room in the boats jump into the cold water up to their waist or neck and attack the animals with knives and hooks. With their sharp knives they cut the necks of the whales into the vertebrae, others throw iron hooks into the animals' bellies and heads and pull them on to the shoals. It is an amazing sight, brutal and disgusting beyond imagination. Everything becomes bloody — the harpoons, the men, the boats and the water."

Other whales are also hunted in this fashion and we can see that conservation is a difficult problem, especially in areas where the human population has to live on what the sea offers. Small wonder that in such places everybody takes any opportunity to grasp whatever the sea can provide. Nevertheless, it would be fair to conclude an international agreement giving the Cetacea a close season, and forbidding the slaughter of pregnant females and mothers with young.

PORPOISES
Family PHOCAENIDAE

The **Common Porpoise,** or **Harbour Porpoise,** inhabits the North Atlantic between 30° and 70° North latitude and the North Pacific between 45° and 60° North latitude. Sometimes it swims inland. This species measures $4^1/_2$ to 6 feet in length. Its upper surface is black and its under surface white. It has from forty-four to fifty-six teeth in each jaw, but at times these barely penetrate through the gums.

GREY WHALE
Family ESCHRICHTIIDAE

The **Californian Grey Whale** is not large as whales go, being 40 to 50 feet in length. It has from two to four grooves on its throat, a small head and no dorsal fin.

At one time the Californian grey whale was found in the Atlantic Ocean. Being an inhabitant of coastal waters it was easy to catch and was exterminated there in the early days of whaling. Nowadays, the species is found in the coastal zone of the North Pacific Ocean.

FINBACKED WHALES
Family BALAENOPTERIADAE

These are the finbacked whales and have grooves across the throat, neck and breast down to the abdomen. The number of grooves varies from twelve to fourteen in each species, the head is flat and rather short, the breast fins narrow and pointed and relatively short, the whalebones short and rather wide.

In the old days when smooth whales (whales with long whalebones), were plentiful in the oceans of the world, whalers were not so interested in the finbacks. For one thing they had not so much blubber. For another, they were slim and quick in their movements and therefore dangerous to hunt with the imperfect equipment of those early days. With the decrease in the number of smooth whales, hunters had to be satisfied with species of poorer quality, and, with the invention of the harpoon gun, the finbacks began to suffer.

The **Pike Whale,** or **Rorqual,** is the smallest of the whalebone whales and rarely exceeds 32 feet in length. It has a rather small pointed head, but its body is stout. At its throat it has fifty to seventy lengthwise grooves. The body colour is blue-and-grey or black-and-grey, and white on the underside. On the upper side of the breast fin there is a strong traverse white stripe.

The range of this whale has long been disputed by zoologists. Tomilin says it lives in the regions of the Antarctic and Arctic seas and sometimes even reaches subtropical waters. In tropical waters it is rarely seen. It is most frequently found in the Northern hemisphere, mainly in coastal waters.

Pike Whales are confirmed wanderers. They have been recorded in the Mediterranean and in the Black Sea. Single animals are usual and it is a rare occurrence when three or four of them are seen swimming together. Individuals will follow a ship for a very long time. The "blow" of this species is inconspicuous and can be seen only with difficulty.

The **Sei Whale** is even slimmer than the preceding species and reaches a range of 40 to nearly 60 feet. It has thirty-two to eighty grooves on its throat, the average number being fifty. The grooves do not extend much beyond the breast fins. The sei whale is found in the same areas as the previous species, but it shuns coastal waters.

The **Common Rorqual** is an inhabitant of the Arctic Seas, but it can be seen wandering in subtropical and tropical waters. It appears frequently near the European coast and is regularly reported in the Mediterranean.

This species measure from 60 to 82 feet in length, the females being larger than the males. There are between seventy and one-hundred-and-ten grooves on

Head of Pike Whale

Action of Balaenoptera breaking surface (after Bobrinsky and Matvejev)

the throat and abdomen, the average number being eighty. The colour of the upper jaws is grey, the underside is white. The lower right jaw is white, the left one grey, and this is diagnostic. The inside of the mouth is dark on the right side and white on the left. The tongue too is two-coloured, the right half being darker than the left. This interesting phenomenon has not yet been satisfactorily explained.

The Common Rorqual has between 320 and 420 whalebones in each half of its upper jaw. The first third of the whalebones are white and the remainder grey and blue.

This is a gregarious species which usually forms groups of six to ten individuals; solitary animals or groups of more than one hundred are uncommon. When not disturbed, the common rorqual travels at a speed of 10 to 14 miles per hour, but when hunted it can reach a speed of 20 miles per hour.

It remains submerged for a period of four to fifteen minutes, then surfaces for two minutes to breathe. It blows a cloud of vapour from 12 to 20 feet high which disappears after two to four seconds. When the rorqual is ready to dive the short dorsal fin appears for a few seconds, but the tail flukes rarely show. Exceptionally, the whole body may appear on the surface.

Small fish are the most common prey of the rorqual. It drives them ahead and catches them up in its mouth as if it were a deep net. If the shoal is near the surface of the water, the rorqual will turn over on its side and catch them in its wide open mouth. When its mouth is full it resumes its normal position. Young rorquals are not natural fishers and have to learn by the example of older animals. The female rorqual gives birth to one young about 12 feet long after ten to twelve months' gestation.

Professor Kunsky has described a rorqual hunt in the Faeroes:

"We are at the Faeroe Islands at one of the two whaling stations from which the whalers operate. Small, speedy, whaling vessels, decks loaded with gear are used to search at random in the cold waters. A sailor on lookout scans the grey sea with his field-glasses. When he sights whales all hands become frantic with preparation. The whale has submerged in the meanwhile, but soon appears on the surface again. The whaler soon catches up and all eyes are fixed on the oblong back showing smoothly above the water.

"The harpoon gun has been lowered. It is located in a strong iron block on the bow of the vessel and looks like an old howitzer. It is a muzzle-loader of 4-inch calibre. I tried to lift the harpoon but in vain. It takes two strong men to lift it and insert

it into the muzzle. It is a terrible weapon but it has to be to deal with such a huge animal. The cable is about 500 yards in length, and is attached to the harpoon.

"Now the explosive cartridge is inserted into the barrel from the rear and everything is ready for the shoot. The captain is on the bridge ready to guide the ship and shout instructions to the coxswain and the harpoonist. The whale is rolling and driving forward by strong thrusts of its tail flukes. A shot is fired and now we can see the straw-yellow cable snaking out following the track of the harpoon. The whale is hit and the water foams wildly. The ship slows down and in a moment we see the harpoon in the neck of the whale.

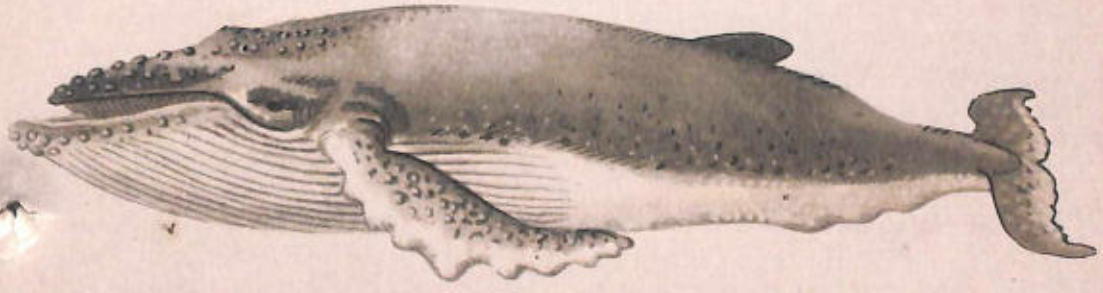
"The pain forces the animal to swim ahead, with the ship following at full speed. The water is now red with blood. There is a second shot and the whale is hit by a grenade which explodes inside it. This is the cruellest moment in the most cruel form of hunting ever devised by man. The whale is now dead and turns over on its back.

"Now an iron tube is forced into the whale's abdominal cavity and the pump drives compressed air through this tube into the body of the whale inflating it like a tyre. If hunting continues the inflated whale is left on the surface of the sea to be picked up later. Whalers take their catch to the whaling station to be processed."

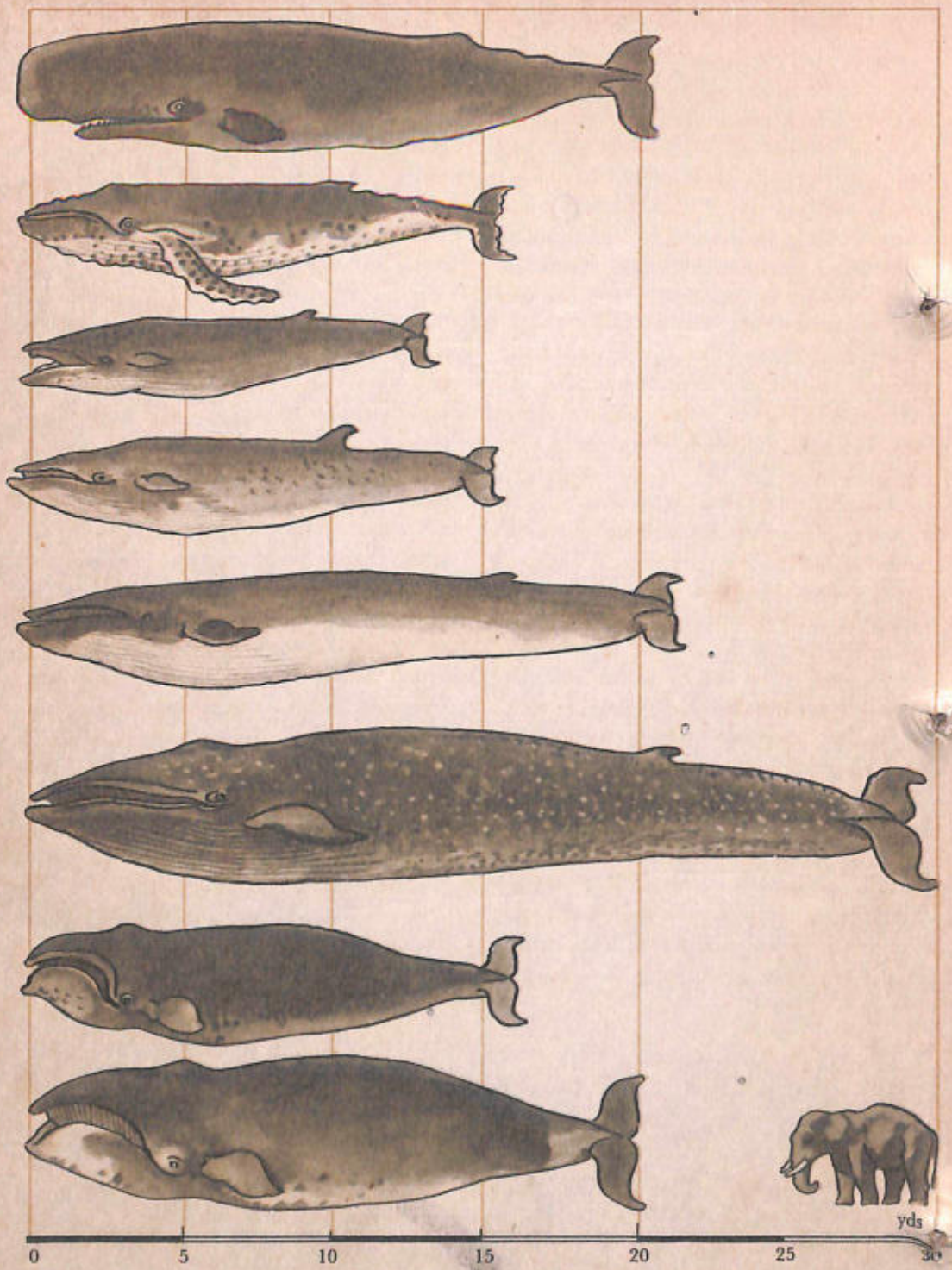
Professor Kukenthal writes of another hunt:

"Now we can see one of the biggest animals of this planet in front of us, and have a clear view of its tremendous size. This one is not the biggest specimen of its kind, being only 60 feet in length. Its cigar-shaped body ends in a horizontal fin which supplies the power of movement. What power there is in this tail fin to drive such a mountain of flesh and bones forward! I estimate the weight of the whale to be between 30 and 40 tons. The skin of its back is bluish-black and smooth, and the head has a beautiful soft lustre. Here and there we can see a few hairs on the upper jaw. We can see the elevated protuberance in which the nostrils are situated. The nostrils are not round. They are two grooves more than $15^{3}/_{4}$ inches long, converging at the front. The eyes are so small that they can hardly be seen. They are situated near the corner of the mouth. The lids are closed because the whale is dead.

"Two masked men in oil-stained overalls begin to work. They have whalers' knives in their hands. They cut out an



Humpback Whale



Respective sizes of (from top to bottom): (a) *Sperm-whale,* (b) *Humpback Whale,* (c) *Californian Grey Whale,* (d) *Sei Whale,* (e) *Common Rorqual,* (f) *Great Blue Whale,* (g) *Black Right Whale,* (h) *Greenland Right Whale*

opening in the whale's back and this enables them to estimate the thickness of the whale's blubber. Now they start working with the knife at the point of the mouth. This is the biggest autopsy I have ever seen in my life. The whale is slashed from head to tail along the middle of the back and at times the knife almost disappears in the blubber. The man now cuts from the corner of the mouth round the jaw, thus loosening the skin and blubber at one side of the head. After the whale is stripped the layer of blubber is seen to be less than half an inch thick and in some places even less. Can such a quantity of blubber justify the slaughter of one of the biggest animals on earth? Are we entitled to kill them in hundreds with guns and grenades for a mere half an inch of blubber?"

The largest of all living animals is the **Great Blue Whale** which reaches a length of up to nearly 100 feet. No animal on earth can compare in size with the female of this species killed off the coast of Scotland in 1926. It was nearly 109 feet in length.

The great blue whale is uniformly grey or bluish-grey in colour with small spots over its whole body. It feeds mainly on crustaceans about $1^1/_4$ inches long. It lives either in pairs or in groups of three. It is an extremely shy animal and when chased can swim at a speed of 23 miles per hour. Like all the whales the great blue whale travels widely between the Arctic and Antarctic regions. Most of them are killed in the Antarctic and only 7 per cent. are killed in the Arctic.

The **Humpback Whale** has extraordinarily long breast fins which reach a third of its body length. The length of the body is from 36 to 52 feet, but exceptional specimens will reach a length of 55 feet. There are fifteen to thirty grooves between the throat and the forepart of the abdomen — noticeably fewer than in the great blue whale. The upper parts are black and the underside white with a clear line of demarcation between the zones. The white underside is sometimes spotted.

It is an interesting fact that the humpback whale always follows the same route on its Atlantic journeys, and appears in the same waters at the same time each year. This has made it possible for zoologists to chart its migrations in the same way as ornithologists can do for birds. The humpback swims slowly and travels at a speed of 4 to 6 miles per hour. During its journeys it rolls and leaps, and makes frequent jumps out of the water.

RIGHT WHALES
Family BALAENIDAE

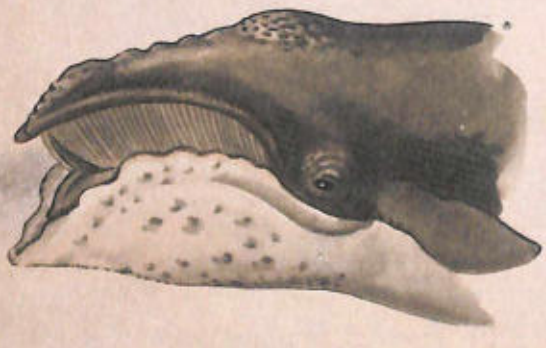
Members of this last group of whales have smooth bodies without grooves and most of them have no dorsal fin. The breast fins are wide and blunt at the tip. The whalebones are long and narrow.

Centuries of hunting almost exterminated the members of this family and it is nowadays a rare thing if the whaler succeeds in killing one. Some of the maritime powers have prohibited the hunting of the Greenland Right Whale.

The best known member of this family is the **Greenland Right Whale.** Its head is so large that it occupies about a third of the body length. The lower jaw is arched backwards at the side. In spite of its large breast and tail fins its speed is little better than a man's walking pace.

The Greenland right whale can dive to depths of almost 3,000 feet and according to Van den Brinka it can reach even 5,000 feet. It can stay submerged for thirty minutes and more. When it surfaces it breathes out a double cloud of vapour from 10 to 14 feet high, slanting forward or backwards. Before submerging again it exposes its tail fin for a short time.

Exceptionally the Greenland right whale reaches a length of nearly 80 feet, but animals of 50 to 70 feet in length are more usual. This species can be distinguished from all other whales by its markings. It is almost black in colour, but the front part of the lower jaw and the rings around the eyes are white. There are between 300 and 360 black whalebones in each half of the upper jaw. These are about $11^1/_2$ feet in length and before the days of plastics the Greenland right whale was killed for its whalebone There is no longer any demand for this, but it may still be too late to save the species from extinction. Despite protection measures there is no apparent increase in numbers.

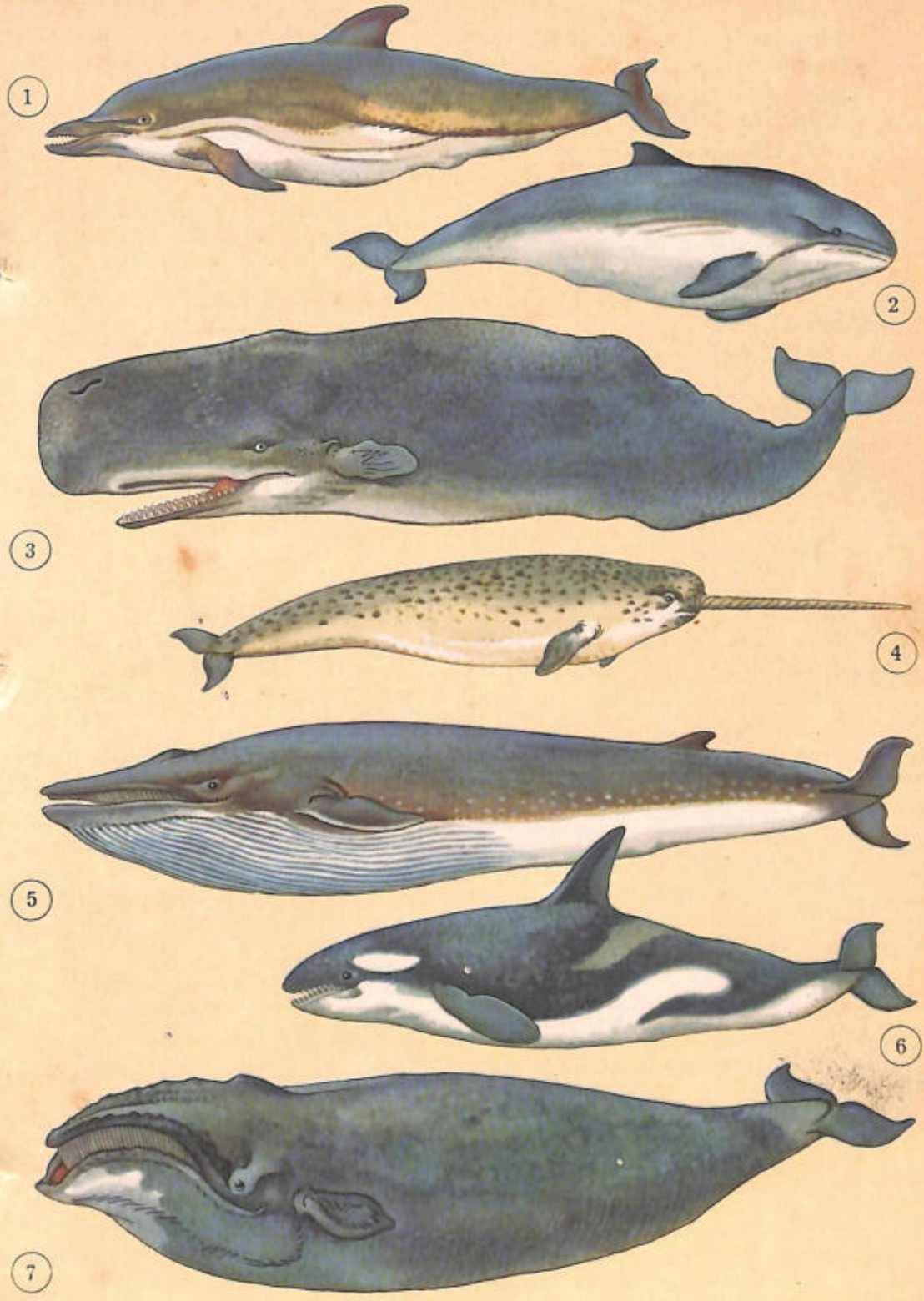


Head of Black Right Whale

Despite all the protection regulations many of these whales are still killed for their blubber. They are big animals supplying between 2,640 and 3,300 gallons of blubber and 430 and 625 miles of whalebone.

The Greenland right whale is an animal of the Arctic seas, to be found only in the regions of floating icebergs. Nowadays it is rarely seen anywhere, but it still occurs in Davis Strait, Baffin Bay and in the Barents, Okhotsk, Beaufort and Bering Seas. According to Tomilin it can still be seen near the Chuket peninsula. Tomilin mentions the fact that, between 1864 and 1876, American whalers killed 194,000 Greenland and Biscay whales in the North Pacific ocean. Between 1911 and 1936, only five Greenland whales were killed near the north-western coast of America.

Very little is known about the breeding of the Greenland right whale. Some zoologists mention June, July and August as the months of mating, but others maintain that the main breeding period takes place in January and February. The females give birth to their young in the cold waters of the Arctic. The newly born young have an extremely thick layer of blubber, a thicker layer than the young of the previous family which are born in warmer waters. Young of the Greenland right whale have a layer of blubber half as thick as that of the adults. We do not know at present how the females give birth to the young. The Eskimos say that the females seek out calm bays with floating ice and that the young are born on an ice-floe. This is probably a legend



IX 1. *Common Dolphin* 2. *Common Porpoise* 3. *Sperm-whale* 4. *Narwhal* 5. *Common Rorqual*
6. *Killer Whale* 7. *Greenland Right Whale*

as all the other whales give birth to their young underwater. It is unlikely that the Greenland right whale is an exception. Females and young live apart from the males.

The **Black Right Whale** is a smaller species than the previous one varying in length from 46 to 60 feet. On its forehead there is a bony swelling, yellow or white in colour, which is frequently covered in parasites such as sea anemones or crustaceans. The body is uniformly black, but there are sometimes a few white spots on the abdomen. The black right whale is found in the regions of the Gulf Stream. Formerly it travelled in summer to the Faeroe Islands and sometimes even to the Spanish coast, the Azores and the Mediterranean. There are two types in this species — the North Atlantic type which has been almost exterminated and the Pacific type which is still found round the coasts of Northern Asia and America.

ORDER: TUBULIDENTATA

AARDVARK

Family ORYCTEROPODIDAE

This order has only one family containing one species — the aardvark, also known as the earth-pig or ant-bear. Zoologists have accorded it this independent status because it is one of the most remarkable animals on earth. It has a long, pig-like snout and great donkey ears. It is stoutly built, has a muscular tail like a kangaroo, a curved back and powerful clawed feet. A fully-grown aardvark measures 50 inches from its nose to the root of its tail and weighs up to 150 pounds. The tail measures $23^1/_2$ to $27^1/_2$ inches. The flanks, legs and face have bristly hair like a wild pig. The tongue is elongated and extensile.

The **Aardvark** is an inhabitant of close canopy forests in Africa, wherever termites are found. Its bizarre appearance puzzled the first African colonisers, as scientists were to be puzzled later. There were great disputes about how it should be classified and up to the present day it will be found classified with the Edentates in many text books. Zoologists now agree that it is in fact a primitive even-toed ungulate.

As we have seen, the aardvark is the sole representative of the order Tubulidentata. The name given to the order refers to the unique tubular structure of the aardvark's cheek teeth. There are no canines or incisors in adult animals, but in the milk teeth it is possible to distinguish canines, incisors and molars. The teeth of the adults have no enamel and no roots, but the milk teeth have roots. The teeth of the adult aardvark resemble those of tapirs and dugongs. The few teeth it has are highly specialised and sufficient for grinding the bodies of the termites which form the animal's food.

The evidence available suggests a relationship to the ancestors of hoofed animals and the shape of the skull is a further indication of this. The lower jaw can perform the same masticating movements as a cow's. The structure of the brain is similar to that of the hoofed animals and the long claws are in fact modified hoofs. The aardvark's antiquity is further indicated by certain features it has in common with the insectivores and marsupials. The aardvark's superficial resemblance to the ant-eaters is the result of its similar way of life and not because of any true relationship. Like the ant-eaters it preys on termites and, like them, it tears open the termites' nests with its strong claws. Like them, again, it gathers hundreds and thousands of termites on its long, sticky tongue. It has similar salivary glands to the ant-eater and a muscular stomach designed for the crushing of termites.

The aardvark is nocturnal and has dark eyes about the size of a rabbit's. Its most perfectly developed sense is that of smell, although the hairs of its snout are sensitive, tactile organs. Its hearing is good and, just like the hoofed animals, it wags its long ears in all directions to catch sound.

The aardvark has to depend on its highly developed senses of smell and hear-

ing because it is otherwise defenceless. When threatened it seeks refuge by burrowing and it can literally dig itself out of sight in a few seconds. Heuglin writes:

"The ant-bear is an immensely skilful burrower and a few moments are sufficient for it to disappear into the ground, however hard it may be. While burrowing it uses its strong foreclaws and throws large clumps of earth behind it at incredible speed. The hind feet are used to push the excavated soil away and the animal works in a cloud of dust. Within a few minutes, the whole body has disappeared into the ground. No enemy can follow the aardvark into the ground because the flying clods of earth frighten it away. Not even man can succeed in digging out an aardvark because he becomes covered with earth and sand within a matter of minutes."

Little is known about the aardvark's general habits. We know that it begins hunting at dusk and returns to its den before daylight. The den is a considerable excavation about 10 feet deep with a number of exits and a complicated network of corridors. The aardvark keeps its den

Aardvark

absolutely clean. It buries its excrement in the same way as cats. Nevertheless, it is not difficult to discover its den because its urine and scent glands produce a powerful, unpleasant smell. Catching an aardvark is much more difficult because it takes about ten hours to dig one out.

Information about the aardvark's breeding is scanty, but it is known that the female gives birth to a single young whose skin is covered with grey fur. Aardvarks are rarely seen in zoos, partly because they are difficult to transport, but mainly because they are difficult to feed. Some specimens have survived for several years on a diet of grated meat.

ORDER: HYRACOIDEA

The rock-badgers or hyraxes are a small group distantly related to odd-toed ungulates and elephants. They are the smallest hoofed animals, being no bigger than rabbits. They look more like rodents than anything else and the older zoologists classified them as such. Even to-day it cannot be said with certainty to which group they really belong. In some ways they resemble the odd-toed ungulates, while in others they are similar to elephants. They have three short hoof-like toes on the hindfeet and four on the forefeet.

The fur of the hyraxes is short and brown. Above their eyes, and on their noses and chins, they have long feeler hairs. There are similar hairs on the fur of the back and flanks. These hairs are of great importance to species living underground or to climbing animals. They can be regarded as touch organs which keep the animal informed about its surroundings, allowing it to move freely and safely. The hyraxes are skilful climbers and so these feeler hairs are highly developed.

Hyraxes have a special scent gland located on the back, the secretion from which is used for marking territory and for bringing the sexes together. The location of the gland is marked by yellow or white tufts of longer hair. When the animal is excited the hairs stand on end exposing the gland.

Two toes of the hindfeet are hoofed; the third one, the outer, is free and has a split claw which serves as a comb or brush. The hyrax uses this split claw for cleaning its fur, which it does several times a day.

Adult hyraxes have thirty-four teeth but no canines. In the milk teeth the canines are the only ones that are fully developed. Adults have one upper and two lower incisors on each side of the jaw. As in elephants, the upper incisors are changed into small tusks and in old males these are less than half an inch in length and project from the mouth. The upper incisors are rootless and permanent. They are three-edged and covered with enamel. These teeth were a frequent cause of error in classification because they were regarded as canines, and so the hyraxes were classified as rodents. Between the incisors and the tusks there is a wide space like that found in rodents.

The digestive system is interesting because there are three appendices, a phenomenon unique among mammals. The appendices contain special bacteria for breaking down cellulose. The kidneys are similar to those of the odd-toed ungulates, but the sexual organs have many features in common with elephants — for example, the shape of the placenta and the development of the embryo. The period of development in hyraxes is surprisingly long, lasting for seven and a half months. The young are born with their eyes open and are able to follow their mother soon after birth.

The most highly developed sense is that of smell but hearing is also good. Sight is less well developed. Unlike other mammals, hyraxes have a third eyelid, or nictitating membrane, which is drawn over the eye from the inside corner. Being white it is easily seen.

Hyraxes are found mainly in Africa, but one species is found in Arabia and Syria. Most species live among rocks in groups of thirty to sixty animals. In each group, there is a dominant male. The hyraxes feed mainly on fruits and plants, but they will eat

lichens. In their dens they have communal latrines. Like badgers, they are cleanly animals and use these latrines at all times.

HYRAXES
Family PROCAVIIDAE

There are nine known species of hyraxes, or dassies, but they are difficult to distinguish and it may well be that some of them are no more than geographical races. The main differences are in the shape of the molars and the skull. As a result, it is almost impossible to classify any dassie until after it is dead.

The **Tree Dassie** is found in the jungles of tropical Africa. It is an excellent tree climber and lives mainly on fruits and leaves. Most species have up to six young but the tree dassie has, as a rule, only two. It lives in family parties. In this species, the teeth have low crowns. The body colour is dark-brown but there is a conspicuous tuft of white hair on the back.

Tree Dassie

The **Steppe Dassie** is found mainly in East Africa usually on plains, but sometimes at an altitude of 6,000 feet. Nothing is known about its habits beyond the fact that it lives in trees or in old termite nests.

The best known and most widely distributed species are the **Syrian Dassie** and the **Rock Hyrax,** or **Cony.** The latter is almost certainly the species referred to in the bible as the cony. In both species the fur is dark-brown, with golden-yellow hair surrounding the gland on the back. The molars have high crowns. Both species are diurnal and live among rocks, frequently at great heights in the mountains. In Kenya, they have been found at an altitude of over 12,000 feet. They live in large colonies. Although either of these species will live from eight to twelve years in captivity, neither is likely to reach such

Rock Hyrax

an age under natural conditions, because they are preyed upon by many enemies.

A European zoologist kept a Syrian dassie for a year in his flat, and has described his experience:

"I took three young dassies home to foster them. Their mother had died soon after giving birth to them in the zoo. They were only a little bigger than my fist, but their teeth were as sharp as needles and they knew how to bite. From the beginning, they rejected the rubber teat with which I tried to feed them and bit at it fiercely. They would take milk from a thin rubber tube attached to a syringe. Perhaps this reminded them more of their mother's nipples. At first I gave them milk at two-hour intervals, then, later, at four-hour intervals. They did well on evaporated milk and grew quickly, but after two months two of them died suddenly.

"Dissection revealed that they were infested by a special kind of tapeworm. Only the female remained alive and I called her Little Leg.

"Little Leg became completely attached to me and liked sitting on my shoulder better than anything else. She would stay there for a whole day. When I left the house she made it quite clear that she wanted to go with me. She resented being put into her cage and when I let her out again she went almost crazy with joy. When I returned home she could recognise my footsteps and welcomed me by a soft growling.

"At the age of six months she was full of mischief. If I was in my study and taking no notice of her, she would throw down various objects to make me angry. She liked tearing up blotting paper. One day, after I had finished writing, she ate the carbon copy and I had to rewrite the whole page. When I reprimanded her, she tried to make up to me again by snuggling close to me and growling softly.

"Friends who visited me were full of admiration for her climbing abilities. She could climb on to the highest bookcase and leap a distance of more than six feet. She never, at any time, slipped or fell. The more I studied her, the more certain I became that the dassies are not the dull animals the older zoologists considered them to be. My experience was the exact reverse. The dassies, like most of the hoofed animals, have well developed brains.

"No animal could have been cleaner than Little Leg about the house. She used one place as a latrine without ever having been taught to do so."

ORDER: PROBOSCIDEA

Elephants are the biggest surviving land mammals and are the last of a once extensive order. We know from fossil remains that many species formerly existed and that one of these, the mammoth, lived long enough to become a contemporary of man. It survived into the Ice Age and was hunted by primitive man. The mammoth survived because it had adapted itself to the rough climate of that period. It was covered by long, thick fur. Many remains of mammoths have been excavated in North America, Africa, Europe and Asia. In the permanently frozen ground of Siberia, the well-preserved carcasses of mammoths have been found. Deep freezing has preserved them for thousands of years, so that their fur, skin and muscles are all intact. In the Leningrad Zoological Museum, there is a specimen on exhibition just as it was discovered.

In older text books on zoology, the elephants were classified with the rhinoceroses, tapirs, hippopotamuses and pigs, but modern zoology has shown that there is no real relationship. The elephants are in a class by themselves. The modern work on mammal classification by Simpson lists twenty-five species in the present order, twenty-three of them extinct, and only two of them surviving — the African elephant and the Indian elephant.

Elephants differ from all other mammals in having a long trunk which is really an extension of the nose. It is a muscular organ which can be moved freely and has a number of functions. The elephant smells with its trunk, uses it as a touch organ, and grasps objects with it so that it functions like human hands. At the extremity of the trunk there are nostrils and finger-like protuberances. The African elephant has two such fingers, the Indian elephant only one. Because the elephant has such a short neck it could not reach the ground to graze or drink if it had not a long trunk. All food has to be passed to the mouth by means of the trunk and, when drinking, the animal sucks water into its nostrils and then squirts it into its mouth.

An outstanding feature of elephants is their tusks, which protrude from the mouth at the root of the trunk. The tusks are made of ivory, and are in fact a modification of the single pair of incisors in the upper jaw. They are hollow at the root and never stop growing. They may reach a length of nine feet and weigh about 200 pounds each. In the African elephant, the tusks are well-developed in both sexes; but in the Indian species, the cow is tuskless or has small ones not visible outside the mouth. The longest tusks on record are in the British Museum. They are from an African elephant and measure 11 feet $6^1/_2$ inches. Male African elephants have especially large tusks. A pair from an animal killed in 1898 weighed 484 pounds and were sold from Zanzibar to the United States of America. There is a record of a single tusk weighing 257 pounds. This was from an elephant killed in 1900.

What does an elephant use its tusks for? Brehm answers this question:

"Observing African and Indian elephants we realise that the elephant when gathering food uses its tusks as well as its trunk and legs. It digs up roots with them, breaks the trunks of trees with them and pulls off bark with them. Wild elephants usually use one tusk more frequently than the other and, as a general rule, this is the left one. As a result,

the tusks are not of the same size because the left is worn more than the right. The tusks are used only exceptionally as weapons, and many observers confirm that fighting males do not use their tusks. They fight by means of their trunks and bodies. Obviously, if elephants used these weapons in the way a stag uses its antlers, they would inflict terrible wounds on each other."

In each half of their upper and lower jaws, elephants have a single molar which is about 16 inches long and 4 inches high. It has many cross-grinding surfaces connected by enamel. The molars are constantly being worn out but are replaceable. As one falls out, its place is taken by another. This process of replacement takes place about six times during the elephant's lifetime.

An adult African elephant will stand 11 feet or more at the shoulder and weigh up to 6 tons. Cows are about two-thirds of this weight. To carry its great body weight, elephants have thick, straight legs, as strong as pillars. A cross-section of an elephant's foot reveals that it walks on its toes. The sole of the foot slants obliquely forward but a great, elastic, wedgelike pad situated below it gives the foot its flat appearance. This elastic pad enables the huge animal to walk quite silently.

The skin of elephants is extremely tough but almost bare. Hairs are few and scattered, and in old individuals are completely worn down. Young animals are sparsely haired over the whole body. The most noticeable hairs, or rather bristles, grow on the tail near the tip. Elephants have few skin glands but the males have a special gland between the eye and the ear which appears to have sexual significance as it secretes during the breeding season. Females have milk glands with two teats between their front legs. Although the elephant has an enormous head its brain is small and weighs barely 11 pounds. Despite this however elephants are highly intelligent animals, because the brain is very finely constructed and has a large surface area.

Everyone is familiar with the elephants that perform in circuses and zoos. The animals are highly talented and can be taught to perform the most complicated tasks. They have excellent memories and the saying "A memory like an elephant" is proverbial. Because they are so easily taught, they have been used by man since ancient times in peace and war. In India, tiger hunters ride on the backs of elephants, and, to this day, the animals are used in India for carrying and hauling heavy burdens which would otherwise have to be handled by cranes.

Wild elephants form herds of up to one hundred animals. The head of the herd is the strongest bull, but during migratory movements the leadership is taken over by the oldest cow elephant. The cows give birth to a single young after a gestation period of twenty-two months. The newly born elephant stands a little over 3 feet tall and weighs just under 200 pounds. It is suckled for a period of six months, after which it begins to eat green food. It has long been said that elephants can live to the age of one hundred years, but this is now known to be an exaggeration. Captive Indian elephants live on the average between fifty and sixty years and it is unlikely that African elephants live for more than seventy years.

ELEPHANTS

Family ELEPHANTIDAE

The African elephant is not so well known as the Indian and is rarely seen in zoos or circuses, mainly because of the difficulties in hunting it. Despite this more is known about it than about the Indian species because Africa, with its great variety of large, interesting animal species, has always attracted hunters, travellers and zoologists much more than Southern Asia, which is the home of the Indian species. Most of them, however, have written more about hunting elephants than studying them.

The most striking difference between the two species is the size of their ears. In the African elephants they are huge and the ears of an animal of six tons will weigh about 180 pounds. Hunters often took the ears of African elephants, fixed them in a frame and used them as a firescreen. The tusks of the African elephant are longer and heavier than those of the Indian, but its trunk is shorter and its head smaller. The African elephant has two fingers on the end of its trunk which can be pressed together to close the entrance to the nostrils.

Originally, the **African Elephant** was found in all the jungles of Africa and two or three thousand years ago it was found in the north, which was at that time, an area of vast forests and abundant vegetation. In the second century B.C., the Ptolemies and, later, the Carthaginians used Nubian and Libyan elephants in their war expeditions. Hannibal surprised the Roman generals by taking elephants over the Alps. The North African race of elephant has long since died out. During the past century, elephants were found in all African forests south of the Sahara, but the pressure of ivory hunters and settlers drove them to the Equatorial regions, so that the animals are now found in the forests between the Chad Lake 12° N. latitude and Lake Ngami. According to the latest figure supplied by Dr. Grzimek, there are now about 200,000 elephants in the whole of Africa. In many places they are strictly protected, but they are still poached on a large scale. Elephants are still hunted in Africa, but such safaris are expensive. Hunts are no longer dangerous and the descriptions of horrible hunting scenes belong to the past. In the Belgian Congo, 10,000 elephants were killed annually between 1889 and 1946. These figures are based on the number of tusks exported. It is estimated that during this period 585,000 elephants were killed in the Congo. This figure represents almost three times the present total population of elephants in Africa. Half the present population lives in the territory of the Belgian Congo. With the introduction of hunting control, fewer animals have been killed. Despite control however, 5,870 were killed in 1947 and 3,545 in 1957.

Elephants are slow breeders and it has been estimated that in any herd only half the animals are sexually mature and of this number three-fifths are females. The rate of increase is about 6 per cent. but many of the young perish so that only about 80 per cent. of animals born in any year are likely to reach maturity. The adult female produces on average one young every four years.

No wild predator dares to attack an elephant and its only real enemy is man.

Dr. Grzimek has warned that if the elephant is to be preserved at its present level, the present kill of 10 per cent. will have to be reduced to 5 per cent. at most, and that in years of natural disaster, none should be killed at all. The situation of elephants in East Africa has been summed up by Machulka:

"The bogs of the whole river basin of the Nile and its tributaries are the real habitat of elephants and in these areas they have their main hunting grounds. The number of animals living there can only be estimated because systematic counts are carried out only in the middle part of Uganda. The number of elephants living in the area in the 1930s was given as 30,000. The control of elephants is carried out by the elephant control staff of three or four Game Rangers, working from the office. These Rangers are Europeans who have lived for many years in the country. They are experienced hunters and experts in their branch. They are assisted in their work by Africans. Their main duties are to manage and control the herds to see that the protection regulations are obeyed and to ensure that the elephants are maintained within stated limits. These areas, especially Buganda and Buniyore, have always had a high elephant population. The advanced tribes living there cultivated much of the land. Population growth was always hindered by sleeping sickness disease which was formerly rampant in these territories. With the control of this disease, the population began to increase and cultivation of the soil became more widespread. There were thousands of elephants in the territory and these now found part of their range under cultivation. This suited the elephants, but not the farmers who had now a new enemy to contend with. The elephants invaded the cultivated fields, destroying bananas, suger cane and other crops. Elephants like all these items and soon began to penetrate all the inhabited parts of the country pillaging the crops. What the animals could not eat they destroyed by their mere weight and size. The elephant will pull out, break up and trample banana trees and sugar canes, or anything that grows in the fields. It will even try to push down native homes and often literally raises the roof but it can also break down walls, using its massive forehead as a battering ram. The natives have no defence against elephants, and so the government has had to step in. One of the functions of Elephant Control is to encourage the elephants to stay on their own ground and to teach them that man is the master."

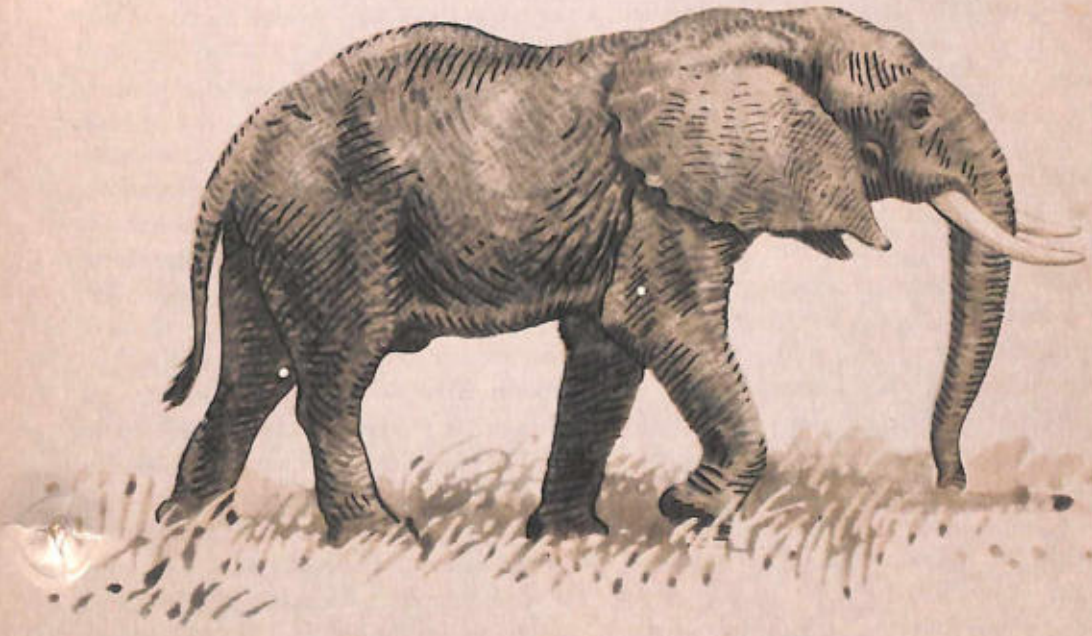
A limit has been set to the number of elephants in populated, agricultural areas and animals in excess of this number were killed off. The permitted kill is often exceeded. Usually about 600 or 800 elephants, males and females, are killed. Control is carried out only by Elephant Control and their personnel. The ivory is the property of the State. As a result of this control, the elephants, which are highly intelligent animals, stay out of the cultivated areas for a time. If they do not they are killed. However, there is no danger at present of the elephant being exterminated.

In 1956, Dr. Grzimek wrote about the control of elephants in the Belgian Congo:

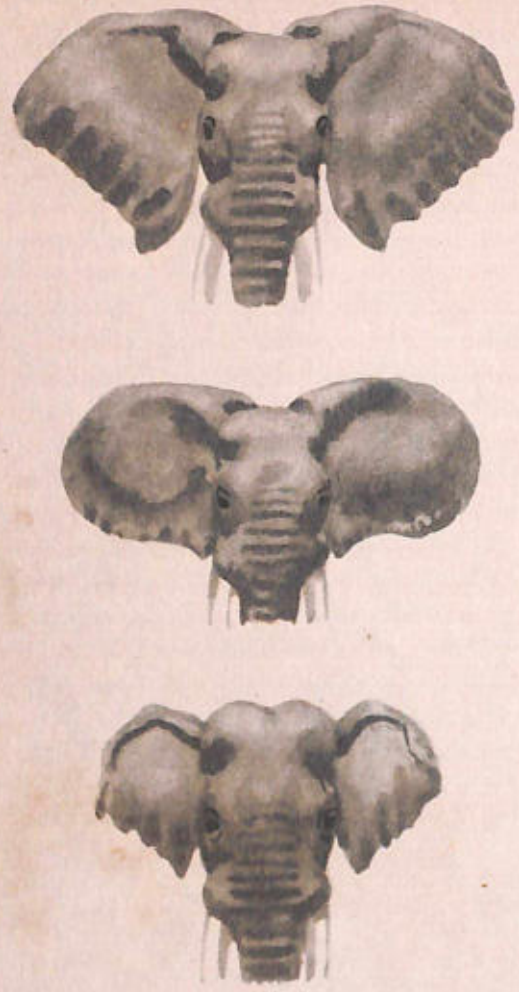
"The elephants were living on the savanna like cattle, standing about during most of the day, especially at midday, and moving relatively little. During the hot period of the day they stood in the shade of trees, nibbling at the foliage. It was

not difficult to approach them, especially if we moved against the wind. Hunting elephants is in no way difficult. In the National Park of Garamba, which begins on the bank of the River Dungu and which covers 1,000 square miles, there are about 3,000 elephants and 500 rhinoceroses. The rhinoceroses are not at all aggressive and can be approached without danger, but in the last seven years three Game Rangers have been killed by elephants. Such fatalities occur in the rainy season when the grass is over 9 feet high, so that a man can come unexpectedly face to face with an elephant. Sometimes, the frightened animal attacks.

"Mr. Offermann, formerly head of the station for taming elephants, observed four big gatherings of about one thousand animals each in the region of the Upper Uele, between the years 1933 and 1938. This happens during a period of drought and usually in the Nambalama and Nagbwangeli regions. There is enough water in the Upper Uele region all the year round, but very little nourishment in periods of drought. The elephants assemble and migrate to forests farther south. The present head of the station, Mr. Lefebre, saw about 250 elephants. According to observations carried out from this station during the hunting season, elephants cover only $2^1/_2$ miles in an hour. If pressed, they will travel about 4 miles in an hour. Their maximum speed is about 18 miles per hour, but they can maintain this for no more than 300 feet. They can, however, run at a speed of 10 to 12 miles per hour for a considerable period of time. In the areas where I studied elephants, the bulls averaged 9 feet in height and the cows $7^3/_4$ feet. One elephant, standing $9^1/_4$ feet tall was weighed in parts after death and these



African Elephant



The shape of ears of African Elephants (above and middle) and Indian Elephant (below)

totalled nearly 6 tons. The tallest elephant kept at the station for the purpose of taming measured nearly 9 feet tall. It was thirty years old."

It is, of course, much more interesting to watch elephants than to take their lives with a gun, and at present many foreigners come to Africa armed with a camera instead of a gun. In this way, much more is learned about the habits of elephants. In the magazine, *Uganda Journal,* I. S. Pery gives some interesting data concerning the breeding of African elephants. Pery examined 150 dead animals, of which 81 were females. He found that 31 of these females were pregnant. His findings confirm that the elephant is sexually mature in its tenth year. Females can have young up to their seventieth year. Mating takes place at any time of the year and young are born in all months. According to this report, we can now assume that elephants in the wild state can live to an age of more than seventy years.

One of the many experts on tropical animals, Machulka, has this to say about his experiences with African elephants:

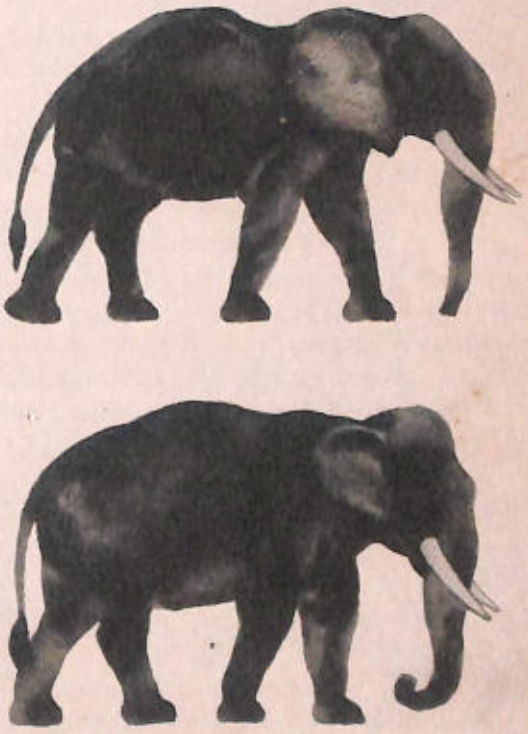
"It is always interesting to observe an unexcited herd and see with what tenderness the males attend to the females. There are many fights among the males. They bump each other with their foreheads and sometimes try to strike each other in the groin with their tusks. A young bull with short tusks has little chance against a mature animal whose tusks are well developed. Small young toddle in the mud and walk under the bellies of their mothers. Cow elephants stand nursing their young from the teats located between their front legs. I have often wondered how it is that young elephants are not drowned in the mud, especially in deep parts of the river with tangles of papyrus roots. However, the cow elephants are good mothers and pay great attention to the care of their prankish young. They always arrive in time to save any young animal that gets into difficulty.

"The elephants search in the water for the young sprouts of papyrus roots, tearing them out with their trunks. They remove the mud by shaking, eat the tops, and throw away the rest. They will pull out even big bunches and shake the mud from the roots on to their backs. The mud

helps to keep away insects. It also assists cooling, although the elephants may prefer to squirt water over themselves with their trunks. This squirting process brings protests from the cow herons which accompany the elephants and buffaloes in the bogs. The herons sit on the backs of the elephants and pick the insects from their hides, or walk around them collecting animals squeezed out of the mud by the elephants' feet. In return, the herons warn the elephants against danger. When the birds see something suspicious they immediately fly away, and the elephants understanding this are alerted.

"Killing an elephant with a single shot is not so difficult as many people suppose. What the hunter really has to know are the vulnerable spots on the large body. During my own expeditions many elephants were killed, most of them by precise shooting; so there was no excitement and no attack by wounded elephants. One member of the expedition reported that they had been shooting the elephants like rabbits. This is an over-exaggeration, because the hunting of elephants is not exactly like the hunting of rabbits. The work is strenuous and tiresome and the hunter requires an exact knowledge of the animal's anatomy. Tracking can be a long and arduous business, especially in boggy regions, and a trail may have to be followed for several days."

There is still a widespread belief that the African elephant cannot be tamed and used for work like the Indian species. In 1900, experiments were carried out in the Belgian Congo at a special station situated latterly at Gandala in the vicinity of the Sudanese border. Originally, the elephants were caught in traps, but this proved to be unsatisfactory. Now hunting is carried on with the aid of a large number of people, using tame animals as decoys. The hunters approach the elephants and begin to shoot into the air, then they follow the escaping herd and rope the young animals which cannot keep up with the older ones. The hunters are dragged for some distance before the elephant tires, then it stops and prepares to attack. The hunter then attaches the rope to a tree. Other hunters place another loop round the elephant's head and fix the end to another tree. Now the tame elephants are called upon to play their parts. They have two cables attached to their bodies. The wild elephant is placed between two tame ones and the loops holding the captive are attached. The young, wild elephant soon calms down and resignedly follows its tame elders. If



Comparison of African Elephant (above) and Indian Elephant (below)

the captive becomes unruly, the escorting animals press in against it. Sometimes young animals are caught directly from the herd. This of course provokes the old elephants to attack, with the result that every year some people lose their lives.

The newly caught elephants arrive at the station between January and March and remain for four months in a shaded corral. They are well fed with boiled maize and rice and get between 7 and 14 pints of milk each day. Now comes their period of training, which is carried out daily for a period of one hour. The elephant first learns to kneel down at a command, then to carry its master and, finally, to pull a cart or a plough. According to reports, tame elephants can pull a heavy vehicle weighing two tons, plus a load of four tons. They can pull such a load for 12 miles at a speed of 2½ miles per hour on good roads. They can pull a two-furrowed plough. The animals work only five days a week and care has to be taken not to overstrain them. Despite their great weight and size they are not machines, and if they are given the same work as a tractor, heavy losses result.

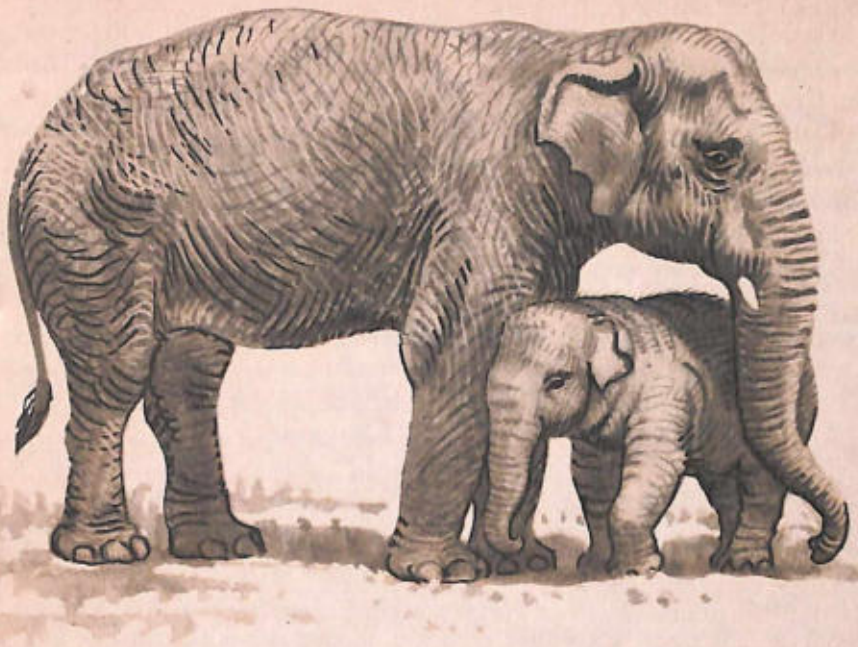
Zoologists recognise several races of African elephant; the East African race has pointed ears, the West African race lives in the great jungles and has rounded ears. In French Equatorial Africa, there is a smaller race whose classification is still in doubt. In the South African reservation there is yet another race.

The **Indian Elephant** is the species best known to members of the public and the one most frequently seen in circuses and zoological gardens. It stands about 10 feet tall and weighs over 7 tons. Its head is proportionately larger than that of the African elephant, but its tusks are smaller and rarely reach a length of 5 feet or a weight of over 40 pounds. The females have no tusks, or only rudimentary ones, and some of the bulls are without them. The profile of the head and body is different from that of the African elephant. The Indian species has a high forehead which ends in two protuberances. The trunk is comparatively long so that the elephant has to carry it with the end curled to keep it clear of the ground. The ears are much smaller than the African elephant's and are triangular in shape. The back slants noticeably towards the tail, whereas the line of the breast and abdomen is level. The Indian elephant has five toes on its front feet and four on its hind. Its general colour is grey and the body is sparsely covered with bristles.

There has always been talk about white elephants, but in fact no elephant is ever really pure white. Occasionally, however, a fallow-haired or white-spotted animal turns up. Such an animal is usually regarded as a king among elephants, or even declared to be holy.

The Indian elephant gives the impression of a wise and calm animal. It is more finely drawn and better proportioned than the African.

In prehistoric times, Indian elephants ranged as far as the Caucasus and Asia Minor. Nowadays, they are found only in India, the Himalayas, Borneo, Ceylon and Sumatra. According to a report published in 1950, the elephants of Borneo are the descendants of imported animals and not native as was previously thought. Three races of the Indian elephant are recognised, each differ from each other in size and shape of their ears, but it is nowadays difficult to distinguish these. Indian elephants have been caught and



Indian Elephant

trained since time immemorial, and moved from one region to another, so that there has been considerable interbreeding with the consequent levelling out of individual characteristics. Much the same thing has happened in the case of European stags.

Indian elephants inhabit mainly wide, continuous forest in lowland, but sometimes in mountain regions; however it has been killed out in many areas. Fortunately, there are still many inaccessible forests in its native country where the herds can live undisturbed. In India, it is now protected by law. Hunting is allowed only for the capture of live animals that are to be trained for work.

Experienced elephant catchers are still highly esteemed in India and the knowledge of the craft is passed from father to son. These men know the number of elephants in a herd, the paths followed by the herds, and can even recognise individual animals and their habits. The most skilful hunters are said to live in the north and north-east of Ceylon. Their only equipment is a strong loop made of stag or buffalo hide which is placed around the leg of the young elephant. Such men are small operators. More frequently, and more successfully, whole herds are caught by hunters working in co-operation. The hunters locate the herd of elephants and surround it with men and tame elephants. A bamboo fence is quickly erected round the herd and fires built up behind it to prevent the escape of the surrounding elephants. Inside the corral, the hunters build a *khedda*. This is a small area enclosed by a firm fence made of high poles and provided with a trap door. Two long fences are erected so that the elephants passing between them have to enter the *khedda*. When the elephants are all inside the *khedda*, the trap door falls down and the whole herd is caught. The main help-

ers in the taming of the wild elephants are the tame animals. They help the newly caught animals to calm down and will punish them to make them settle.

The Indian elephant is well able to work hard on the spot — for example, in the carrying of logs — but it is not suited to hauling loads over a distance. It will carry a load of about one ton for a short distance, but in difficult terrain a load of half a ton is sufficient. The working elephant has to be well cared for and properly fed. In addition, it has always to be given time off for basking.

Visitors to zoological gardens like to watch the elephants and the animals soon learn to look for titbits. In captivity they can learn many tricks, such as playing the harmonica. Circus elephants display a high degree of mental ability.

ORDER: SIRENIA

The four species in this order are divided into two families. They are strange creatures evolved from plant-eating animals, while the whales are the descendants of carnivorous species. The Sirenia acquired their name because they reminded sailors of mermaids and because of the way in which they nursed their young. The animals have therefore been confused with the sirens of mythology. The sirenians are eaters of seaweed. Having lost their hind limbs, and being designed for an entirely aquatic life, they are helpless when washed ashore. Two species are found in the New World and two in the Old World.

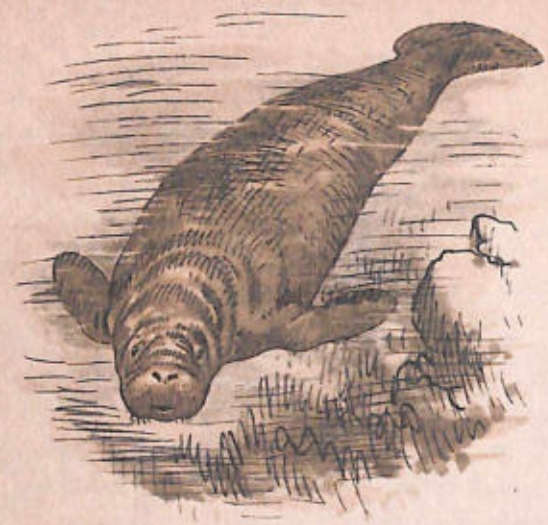
Sirenians have front limbs adapted for swimming. Their young are born underwater and brought to the surface soon after birth. The young animal soon learns to swim with its mother. The mother supports the young animal with her flippers while it is sucking milk from the mammary glands in the fore part of her body. In shallow waters the animals can rest with their heads and their backs above water level.

Like other water-bound mammals, the Sirenians have bodies which are sparsely haired, but the relationship to other mammals can be seen in the embryos which have thin fur. The upper lip is remarkably developed. The ribs are large and heavy. Although the animal has no external ears its hearing is said to be good, but the eyes are weak. The nostrils are like valves. The animals reach a considerable length — between 7 and 10 feet — and weigh on average between 450 and 500 pounds. Young animals weigh about 40 pounds.

MANATEES
Family TRICHECHIDAE

All three existing species of manatee are similarly built. The head is separated from the body by a skin fold. The tail fin is round. The skin is covered with bristly hairs which grow about half an inch apart. The upper lip is cleft by a vertical groove and the parts can move separately. The eyes are small, the eye sockets round and surrounded by an eye muscle. The cornea of the eye is covered by a jelly-like secretion emitted by the eye glands and it was this secretion that gave rise to the notion that the Sirenians could weep. The fore limbs have rudimentary nails on the finger tips, except in the South American species which have none. In each half of the jaw the Trichechidae have five or six teeth, rarely eight. These are regularly renewed so that the animal may produce sixty teeth in its lifetime.

The **West Indian Manatee,** sometimes called the **Lamantin,** is found in the West Indies, off the north-east coast of South America, and the south-east coast of North America. It inhabits warm, shallow, muddy coastal waters and bays, and sometimes moves into estuaries and coastal rivers. During periods of flood, it will penetrate into lakes and boggy regions. It is found even in the Miami River, right in the town, but because of the turbid water is seldom seen, except when



West Indian Manatee

it surfaces to inhale air. The manatee remains submerged for twelve to fifteen minutes feeding, then surfaces to breathe. An adult animal will eat up to 100 pounds of seaweed every day. The species is now strictly protected and any person killing one illegally is fined 500 dollars or sent to prison for three months.

In the more northerly part of their range some of these manatees die of cold. Up to thirty-five animals have been seen on cold mornings along a one mile strait of the Everglades reservation. The animals living in St. John's River in the north of Florida know how to defend themselves against cold. They move into where the water from springs flows into the river and where the temperature is about 20°C. Here they remain during the cold spell and sometimes throughout the winter. In the clear water they can be seen at a depth of $11\frac{1}{2}$ feet, sleeping peacefully, and they can be watched while surfacing to breathe. Sometimes they eat the plants on the river bottom, but during the winter they do not usually eat at all.

Like the West Indian manatee, the **South American Manatee** is sometimes kept in captivity. In 1912, the Hamburg Zoo received two half-grown animals of this species and Dr. Mohr has described their life there. The Hamburg animals were kept in modest surroundings of no great size. The water temperature was kept as far as possible between 25 to 30°C, and the air temperature between 20 and 25°C. Humidity was maintained at a high level. When the animals reached the zoo they were six months old. They measured about 3 feet in length and weighed over 40 pounds. They grew quickly and by the end of the third year had doubled their length and each of them weighed 275 pounds. When they were eleven years old, they measured $6\frac{1}{2}$ feet in length and weighed between 440 and 550 pounds. They were not difficult to feed and swallowed everything, including the loam and the mud. Perhaps the turbid water was welcomed by them as protection. They ate their own excrement and the excrement of other animals. In their first year they were given between 10 and 15 pounds of food each day, but this was soon increased to between 30 and 40 pounds. This pair survived in the Hamburg Zoological Garden for over ten years.

The **West African Manatee** is found off the coast of West Africa. It is not confined to the sea but migrates up the rivers to considerable distances inland.

DUGONGS

Family DUGONGIDAE

The dugongs are similar in shape to the manatees, but their tail fin is not rounded. It is notched like the tail of the whales. The body is sparsely haired. The lips are different from those of the manatee. The mouth of the dugong has been described by Dexler and Freund as follows:

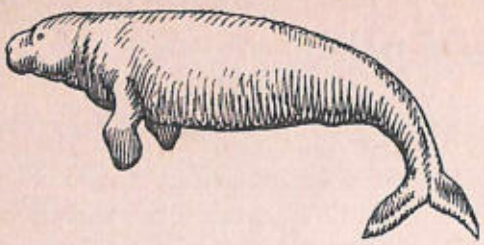
"The snout is soft and consists of strong muscle layered with blubber. The lip is covered by skin which is so soft that it can be folded between the fingers. The mouth is cut obliquely at the front and looks as though it were separated from the head, giving the animal a peculiar profile. In many places, dugongs have been exterminated. They live in the shallow waters of sea bays, in the Red Sea, off the east coast of Africa, near Ceylon, in the Bay of Bengal, in the water of the East Indian Archipelago and the Philippines, and near the north coast of Australia. They are most frequently found in the waters of Ceylon and Madagascar. Formerly, three species were described by zoologists. Nowadays, the general opinion is that all the dugongs belong to the same species."

The **Indian Dugong** is a little known species and much of the data available is inaccurate. A male measuring 9 feet in length, weighed 370 pounds. A female, 8 feet in length, weighed only 300 pounds. The dugongs graze on the sea bottom as cattle do on land and feed mainly on seaweed and sea plants. For this reason they are often referred to as sea cows. They tear out whole plants from the sea bottom and shake them vigorously to rid the roots of sand and mud. They surface at regular intervals to inhale air. Observers have reported that the animals make puffing noises when exhaling air. There is no exact information about the length of time the animals can stay underwater. Some authors mention one minute, while others say ten minutes.

The dugong gives birth to a single young after a gestation period of about eleven months. This is confirmed by the observations of Dr. Mohr:

"In July, 1905, a freight steamer was passing off the coast of Haramil Island in the Red Sea. Suddenly the captain saw what looked like three people floating upright in the water, heads and chests showing. He thought they were shipwrecked and stopped near them. What he had seen was a family of dugongs that

Indian Dugong



Steller's Sea Cow (reconstruction)

did not want to be rescued and all of them submerged. When the animals appeared again the captain shot the biggest one in the neck. The wounded dugong swam to the island, followed by the others. All three soon reached the rocky shore where the water was shallow and, here, the sailors had no difficulty in catching the wounded male, who allowed himself to be bound up without resisting. The female and the young animal were caught in the same way. The captives were put into a big tank and fed on fish. The female was still nursing the young animal. In this narrow tank, the dugongs lived for two months, but the wounds and the unsuitable food combined to kill the male. The female spent her time searching for the male and neglected the young. A week after the male's death, the female died too. Shortly afterwards, the young animal died as well."

The Ceylon fishermen catch dugongs in big nets, while the Australian natives kill them with spears. The meat of the dugong is not palatable, but the blubber is in some demand. A large animal produces between 50 and 100 pints of blubber.

Steller's Sea Cow is now extinct. It was discovered by the Russian sailor, Bering, in 1741 in the Bering Straits. At that time, there were several thousands of these animals still alive, but by 1768 all of them had been killed by Russian hunters. Steller's sea cow measured about 30 feet in length and weighed up to 3 tons.

ORDER: PERISSODACTYLA

Perissodactyla is a Greek word meaning "odd fingered". This order has three families — rhinoceroses, tapirs and horses — making up a total of sixteen species. The families differ considerably from each other in appearance but have one feature in common — the axis of the foot passes through the middle toe. This means that the weight of the body rests on one toe only — the third, which is the most highly developed. The remaining toes are smaller, or vestigial, as in the case of the horse. Although the odd number of toes is characteristic of the order the tapirs have only four toes on their forefeet. The order is notable for the small eye-teeth which in some species are absent altogether.

The great days of the perissodactyls were in the Tertiary period of the Eocene when there were about 159 genera. These have now been reduced to six, so that the present-day odd fingered mammals are a mere remnant of a once great Order. Present-day types are large herbivorous animals and most of them are good runners. They have a simple stomach and no gallbladder.

HORSES, ASSES AND ZEBRAS
Family EQUIDAE

Horses continued their evolution long after the tapirs had becomed fixed in appearance. This is especially true of the horse's limbs. The formerly five-toed horse has now only one developed toe — the middle one. Of the second and fourth toes only small splints remain.

Palaeontology, which is the science concerned with the study of extinct species, has shown that horses have changed greatly since Tertiary days and this is especially true of their limbs. Changes in environment were mainly responsible for their progressive development. The early ancestors of the horse lived in humid, boggy regions; then, latterly, they became animals of the plains. Five toes were useful to animals living on soft terrain, but on hard plains a hard, narrow hoof was more suitable and thus evolved the one-toed horse.

The hoofs of horses are composed of a thick layer of horny matter similar to the nails or claws of other mammals, but on horses this horny matter covers the entire last joint of the toe. On the insides of the forelegs and under the hocks horses have special horny formations known as chestnuts, which are probably the remnants of scent glands. Being animals of the plains, horses feed mainly on dry herbage and their teeth have high crowns with special folds of hard enamel. They are constantly being worn down by grinding but are maintained by constant growth. There are six molars in each half of the jaw. The eye-teeth are stunted and are missing altogether in mares. The muzzle is soft and mobile and the lips more developed than in most other animals. In the horse you can see some resemblance to the sensitive and soft nose of the elephant — that is, its trunk.

All present-day members of the horse family have preserved the typical body shape.

Originally, wild horses were found in most parts of the Old World and some of them survived in Europe into modern times. To-day their distribution is much more limited and the relatives of the horse are found in Asia and Africa. Members of the horse family live mainly in herds. Their most usual pace is an easy, graceful trot, but when pressed they are able to run fast and far. All of them have good senses of smell and hearing, and when warned of the approach of an enemy depend on their speed to take them out of danger. The wild horse defends itself by biting and kicking.

Man is the greatest single enemy of wild horses everywhere. In some parts of the world he killed them out by shooting or drove them to inaccessible wastelands. Losses in a herd cannot be replaced quickly as all species are slow breeders. The mares have only one foal at a birth and carry it for a long time. Some wild horses were tamed by man who, in time, evolved many types suited to different types of work.

The horse family is divided into three groups — zebras, asses and true horses. The true horses are mostly of a single colour with no striping. Long hair grows almost from the root of the tail and they have chestnuts on the fore and hind limbs. The tail hair of asses and zebras grows at the end of the tail or from the middle and they have chestnuts only on their fore limbs. Asses are of a single colour but zebras are partially or completely striped. Some zoologists believe that all forms were striped originally and that the ancestors of the modern horse were striped like present-day zebras.

Zebras are typical African wild horses and are found nowhere else in the world. They are as typical of Africa as kangaroos are of Australia. The zebra herds are found mainly on the vast plains of South and East Africa but herds numbering up to a thousand animals are things of the past. From the early days of the colonisation of Africa man has killed the zebras mercilessly. In the Boer settlements the slaughter of these animals was often carried out in a barbarous fashion. Zebras are slower than horses and do not have their endurance. The Boers, on horseback, used to amuse themselves by running down and stabbing the zebras with long knives, competing with each other to see who could kill the biggest number of animals. After such a hunt the plain was strewn with wounded zebras trying in vain to stand. The bodies were left for the vultures. After the colonists came the safaris of white men hunting zebras for sport. They used modern rifles. The animals were killed for sport and their flesh was left for the hyenas and vultures. Small wonder that zebras, once common in all the territories of East and South Africa, were soon confined to small areas and drastically reduced in numbers. Some species or forms were completely exterminated.

Classifying zebras presented zoologists with many problems and there was much dispute about it. There is now much more agreement on how the individual species should be dealt with. The main features of zebras are the shape of the head and ears and the number and pattern of the stripes, especially the stripes on the back and the legs.

One group of zebras is similar in head shape to asses; the other group more closely resembles the horse. In the group resembling asses, those species with heavy and long heads, there are two kinds — the Mountain Zebra and Grevy's Zebra.

The **Mountain Zebra** is the smallest species and stands 4 feet tall at the shoulder. This species is striped on the head, neck, body and legs right down to the hoofs. On the hind-quarters the stripes are broad and widely spaced. On the rest of the body they are narrow and close set. On the rump there are crosswise stripes. The mountain zebra has a distinctive Adam's apple on its throat.

This species was found in a small region of South Africa north-west of Cape Town, and it was once found in large numbers in the mountains and plains of that area, although the individual herds were small. With the colonisation of South Africa the mountain zebras began to diminish in number. They are now protected by law in the Gradock region of Cape Town but their numbers are increasing very slowly. In one year only seven foals were born in Gradock. In Dornholk fourteen were produced in two years. Rigid protection enabled the Dornholk herd to increase from seven animals to forty-three between 1922 and the present day. The present-day population of mountain zebras is sixty.

Hartmann's Zebra is more numerous and is found in the western Damara region of South Africa. It is nowadays regarded as a race of the mountain zebra and it too is threatened with extinction.

Grevy's Zebra is the second of the species of the ass-type. It is the tallest of all the zebras and reaches a height of $5^1/_4$ feet at the shoulder. It is a northern species inhabiting the vast mountainous regions of Abyssinia, the Southern Sudan, Somalia and Kenya. In this species the long ears are rounded at the tip. The striping is close and fine on the head, neck and body, and extends down to the hoofs. There is a broad stripe along the spine. On the rump the stripes become smaller instead of bigger as in other species. Like the mountain zebra, Grevy's is found only in small herds and frequents high ground in grassy and bushy regions. Because of its great beauty, Grevy's is commonly kept in zoological gardens. The species was first described in 1905 when a specimen was sent by the Emperor Menelik to the French President, Monsieur Grevy. However, old drawings show that the animal was known in Europe long before then. In the Paris Museum of Man there is a rare tapestry work depicting the birth of Christ. On this the animal standing beside the crib is a Grevy's zebra instead of the customary ass.

All the other zebras, which have smaller horse-like heads, are included in one species with a whole range of forms. Although colour and markings vary widely among the individual forms, there are no physical or skeletal differences.

One of the most remarkable zebras was the **Quagga,** now extinct. Fortunately a few photographs of the species have

Quagga

been preserved. There are only nineteen specimens preserved in the museums of the world. Of these only one can be seen in Africa — in the Cape Town Museum. Three photographs of the quagga kept in the London zoo from 1851—1872 are published in a number of books. The quagga was exceptional among the zebras in being striped only on the head, neck and shoulders. The rest of the body was a uniform brown colour. The legs were pale and unstriped.

The extinct quagga could once be numbered in millions, but that was before the white colonisers appeared in Africa. Today nobody knows what a quagga is, and a skin or a skeleton is the most that anyone can see. It is difficult to realise that this was once one of the most common animals of Africa. In 1878 the last wild quagga was killed, like so many of its kind, by a bullet. The last captive specimen died on the 12th August, 1883, in the Zoological Garden in Amsterdam. Zoologists did not then realise that the quaggas in the various zoological gardens were the last living members of the species and the incredible report of its extinction as a wild animal came too late for the species to be saved by the breeding of captive animals. Those still in the zoos were then too old to breed and so the quagga ceased to exist.

Burchell's Zebra

All the quagga's relatives are striped in the same way as other zebras but, unlike the mountain zebra and Grevy's zebra, their dark stripes are broad and widely spaced so that the light colour of the body can be plainly seen. Identification of the various races is based on the striping.

Burchell's Zebra became extinct when the last specimen died in the London zoo in 1909. It was found in a small area of Bechuanaland. In this species the striping on the rump became fainter towards the legs, which were white.

Chapman's Zebra is still found in the eastern areas of South Africa and is frequently seen in zoological gardens. In this species there is fainter striping between the bold, dark stripes on the rump.

Bohm's Zebra is the commonest species still surviving in Africa and nowadays **Grant's Zebra** is included with it. Above the black mouth there is a brown nose spot. This race is found north of the territory occupied by Chapman's zebra, that is in Mozambique and Kenya. These zebras live in large herds on reservations, where they are now in no danger from man. The herds are frequently seen in company with other animals of the plains — antelopes, gnus and ostriches. Where lions are present they prey largely on the zebra herds.

All experts on African mammals are agreed that the zebras are the most trustful of man and in the African reservations motor-cars can approach within close

range so that tourists are able to take close-up photographs. Bohm, the zoologist, after whom this type is named, has written the following description of the animals:

"They are found mainly on the open plain, but during the day can be seen sheltering from the sun and flies wherever there is tree cover. They crowd together in the shade and stand motionless. The herds return to the open plain after sunset, often travelling in Indian file. In the evening they follow the leading stallion to the watering place and are often seen in the company of gnus and antelopes which are much more alert than zebras."

Man has often tried to tame the zebra and the Boers used to catch them by means of a pole with a long loop at the end which was drawn over the zebra's neck. We have already mentioned the fact that horses are able to outrun zebras with ease, but nowadays zebras are caught up for zoos in a still easier way, namely by motor-cars. Dr. Ullrich has described such a chase:

"Willy was on the roof of the car spying the low ground with his binoculars. Suddenly he spotted a herd of zebras in the distance. We approached until we were about half a mile from the herd and then worked out our plan of hunting. I have to take up a position on the edge of the trees with my camera. The hunting car will then go round the herd in a wide circle and try to drive the zebras on to a treeless, grassy plain. The car disappears in a cloud of dust behind the thorn bushes and I fix the camera on to its stand, fit it with a telephoto lens and start a new roll of film. Piet is watching the car through his binoculars. He calls out to me to get ready as the herd is approaching. Then, suddenly, he stops. The zebras have swerved aside and the car has to go round them once more.

"This time the manoeuvre is repeated at slow speed as the zebras must not be over-strained. In about thirty minutes the herd is approaching again. As soon as the animals are on the open plain William starts driving the hunting car at full speed. The zebras now run wildly trying to break away. The car closes in on them with Willy sitting on the left mudguard holding in his hands the long pole with a loop on the end. He is strapped to the mudguard for safety. With the telephoto lens trained on him I film his every movement. The zebras are now stampeding on lava dust and the car disappears for a time in the dust clouds. Willy, with his eyes half closed, is now concentrating on hunting a young stallion. Now and again he glimpses it through the dust and signs to William to increase speed. In a few seconds the speeding car is cutting out a small group of animals from the herd. The young stallion tries to swerve aside to follow the escaping animals, but William, swinging the car round on two wheels, heads it off. Willy now swings his catching pole and in the next instant the loop is round the stallion's neck. The pole falls, the car brakes hard, the stallion rears, pulling against the rope and kicking, but it quickly gives up and is soon standing calmly. I run with my camera towards the captured zebra. The Negroes have left the car and put another rope round the stallion's neck. William drives back to the safari to fetch the cart and cage. But this is not needed; unexpectedly, the zebra behaves quietly and allows himself to be led away on the ropes. He does not rear or kick and behaves indeed like a tame animal from a circus."

All zebras thrive in captivity and will breed without any difficulty. They have been bred with horses and asses, producing sterile zebroids, but these hybrids could never compare with horses as working animals and such cross-breeding never became of commercial value.

Wild asses are divided by some zoologists into two separate groups. In one group they place the grey African asses, which have very long ears and the so-called shoulder cross. In the second group they place the Asiatic asses, which are yellow in colour with shorter ears and no shoulder cross. The latter are referred to as semi-asses. We shall accept this division here.

African wild asses lived in regions where there were no zebras, in the North and West. There was only one species which formed two geographical races. The first of these was the **Nubian Ass,** which was grey or yellowish in colour and stood from 44 to 46 inches tall at the shoulder. It had a dark line along its spine and the cross stripe on its shoulder blades. This race was originally found from the Nile valley eastwards between 5° and 18° latitude. Westwards it was found as far as the Tibesti mountains. Although we have referred to this race in the past tense it is by no means certain that it has been exterminated; lately, herds have appeared in the centre of Africa. It has been suggested that these herds are the descendants of gone-wild domestic asses, but Malbrant states that they are larger than domestic asses and can be regarded as animals of the original wild stock which have escaped the attention of zoologists and of the local population. In the list of Nature Reserves this race is described as being threatened with extinction. There is a note reading "several groups are scattered in the Sahara desert".

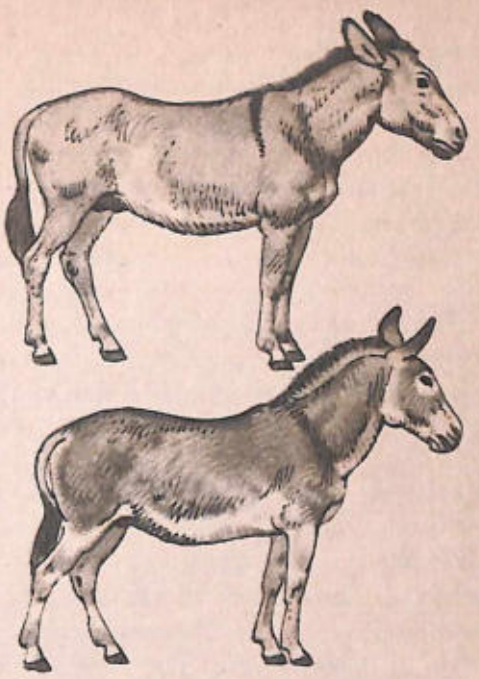
The second race of the African species is the **Somali Ass.** The Somali ass has no shoulder cross but there are faint lengthwise stripes on its legs. It is found in the north of Somalia and in the coastal areas of Aden Bay. It lives a spartan life and can survive on sandy and stony lowlands near the coast where the only food is tough mimosa thorns and woody grasses. The Somali ass is also found in mountain areas and on high plateaux where it is seldom seen by man. It can exist in the most desolate stony regions where it is troubled neither by lions nor man. Anyone who sees the wild ass in Africa is fortunate indeed as the animals are incredibly shy and wary. Such habits help to explain the reports of their extermination.

The Nubian ass can be regarded as the ancestor of the domestic donkey, which also has the shoulder blade cross and unstriped legs, but it is impossible to determine when man first tamed the wild asses. We know, however, that asses were kept as domestic animals by the Ancient Egyptians and bones have been found in certain Iron Age excavations. It can therefore be said that the ass was one of the earliest domestic animals. As a result of selective breeding many forms have been evolved differing in size and colour. In most cases the domestic ass is grey, but it can vary from very light grey to near black. In cold regions the asses grow a long, thick coat for the winter, but in warmer regions their hair remains short throughout the year. The tallest breeds compare in height with small horses but on the Balearic Islands, Sicily and Ceylon, small races have been

evolved which stand less than 31 inches tall at the shoulder.

Is the ass a stupid animal? Are we justified in saying to anyone "you are an ass" when we wish to imply the person is a fool? We are not justified because we know that wild asses are far from foolish and the only justification for calling the domestic ass a fool is that it works hard for man without complaining. The ass is long-suffering and man mostly repays it with ingratitude. In many parts of the world the animals are overworked. In Bulgaria, where many asses are kept in mountain villages and fishing villages, they have to carry loads out of all proportion to their size and strength. In mountain passes caravans of asses can be seen loaded with cement for the building of a water reservoir. Other caravans toil up the steep slopes loaded with barrels of petrol or oil for filling stations. In the narrow street of a fishing village we often see an enormous bunch of bushes and sticks in motion and only when we come close to it do we realise that there is a small ass underneath, walking with difficulty on its slim feet and nodding its wise, long-suffering head. Any day one can see a small ass carrying on its back a big man whose feet touch the ground. Scenes like these are common everywhere in Southern Europe.

No one envies the life of the ass, which is unenviable in the extreme. After a day of hard work it is given a little dry grass as fodder, food which a horse would not even look at. Then, during the night, it is tied behind the house or hobbled and left out of doors. Although it is not particular as far as its fodder is concerned, the ass likes its water pure and would rather go thirsty than drink polluted or muddy water. It can be a stubborn animal and



Nubian Ass, Somali Ass

if it takes it into its mind to stop it will stop and will not be forced to continue on its way with beating or rebukes, but it would be a mistake to regard it as a foolish animal. If we insist on attributing human qualities to animals, we may say of the ass that it bears fate with resignation. In the mountains they walk surefootedly, despite being overloaded with heavy burdens. They have good memories and once they have travelled a route they will find their way again with certainty and without guidance.

The well-known braying of the ass, usually rendered as "hee-haw" and accompanied with four or six hoarse sighs, is not pleasant to the human ear and when all the asses in the vicinity join in the noise is deafening.

Cross-bred animals deserve special mention. These are obtained by crossing an ass stallion with a horse mare. The result-

ing foal is known as a mule. The mule inherits the best qualities of the ass and the horse and is still used in many parts of the world as a beast of burden, especially in mountains and over difficult terrain. As late as the First World War, mules were used for hauling guns and ammunition in the battle zones. They can carry a burden of up to 3 hundredweights along the most dangerous tracks. The reverse cross between a female ass and a horse stallion produces an inferior hybrid known as a hinny. In its nature and stature the hinny remains very much an ass. They cannot compare with the mule and so are seldom used. They are, in any case, not so easy to produce as a horse stallion will only rarely breed with a female ass. Both types of offspring, hinny and mule, are sterile and cannot breed.

The asses of Asia were formerly regarded as independent species but according to Ellerman and Morrison-Scott, and later modern Soviet researchers, they can all be regarded as races of the **Asiatic Wild Ass,** or **Kulan.** Asiatic wild asses are found over the greater part of South and Central Asia, namely Iraq, Syria, Persia, Baluchistan, Western China, Mongolia, Nepal and Tibet.

The kulan is more like a horse than an African ass. It is slimmer than its African relatives and has shorter ears, but it still differs from the horse in having a big rough head and a tail which has hairs only on the lower half. The kulan usually measures about 8 feet in length and stands about 4 feet tall at the shoulder. The upper part of the body is yellowish brown but the mane is almost completely black. The tip of the muzzle, the throat, chest, abdomen and the inside of the legs are lighter than the back. A dark stripe runs along the backbone to the upper part of the tail. The summer fur is short; the winter fur is longer, softer and darker. The kulan lives on steppes and semiwastelands and its colour matches that of its surroundings.

Rozanov and Flerov have written about the kulans in the U.S.S.R.:

"Until recently the kulan and its related races, the Chigetai of Mongolia, were widely spread over Central Asia and the southern steppes of Western Siberia. They could even be seen in the west along the eastern Urals and near the coast of the Caspian sea. They even penetrated into the Baikal steppes. The settlement of remote regions of Central Asia, the increase in cattle grazing and especially the increase in hunting, have pushed the chigetai from the territory of the U.S.S.R. At present kulans can be seen in herds of several hundred only in small areas of Turkmenia in Serach and Kushkin near the Iranian and Afghanistan border. Today the hunting of kulans in the U.S.S.R. is absolutely prohibited and severely punished."

In Turkmenia they have been given an extensive reservation. In Mongolia, where kulans are more common, only a few animals are allowed to be killed — probably less than fifty a year.

Bannikov reckons that tens of thousands of kulans still survive on the vast territory of Mongolia, but even there their numbers are dwindling. This is not so much the result of killing as to a lack of watering places, most of the water now being used by man.

Professor Bannikov in his book entitled *The Mammals of the People's Republic of Mongolia,* devotes fourteen pages to the kulan which sum up most of what is presently known about this animal. Kulans

do not like wide open spaces. They prefer mountain valleys in areas near lakes. The upper limit of their range is about 6,500 feet, but in Tibet where the steppelands are higher they can be seen at 16,000 feet. During the day the kulans range the steppes eating grass, and once a day, towards evening, they visit the watering places to drink. Bannikov has watched them drinking at sunrise, so it is obvious that the time of drinking is influenced by several factors. If the animals have to go without water for several days (and this happens quite often), they will drink as soon as they arrive at a watering place.

During the night the herds of kulans frequent sheltered places in the valleys or among scrub. Small groups of seven animals are led by an adult stallion. The group is made up of she-asses and young animals of one or two years old. So far nobody has been able to explain why kulans sometimes congregate into large herds, but it may be the result of local banding in search of fodder. Przewalsky wrote about such large herds in the year 1875 and mentioned that near Lake Koko-nor he saw herds of one hundred animals. We know that, later, herds of five hundred or six hundred animals were observed near the Tost mountains and were described by Kazakevic in 1927. Andrews, the expert on Mongolian asses, saw a herd of about 1,000 kulans in the region of Congan-nor Lake in 1925.

Kulans breed in the month of September when there is fierce fighting among the stallions. There is a courtship period before the actual act of mating which has been described by Bannikov as follows:

"In the latter half of July we were able to watch stallions at play. They were running round their herds, dashing forward, lying on their backs, rolling, neighing and leaping in the presence of the mares. From time to time they would leap straight into the air. During these demonstrations yearlings and two-year-olds leave the herd. The stallion keep a strict watch over their mares and defend them against other stallions."

The best-known races of kulan are the Chigetai, the Onager and the Kainj.

The **Chigetai** is a true kulan and inhabits Mongolia and adjacent areas. The wild asses of Persia, Afghanistan and Soviet Turkestan are known by the old name **Onager.** They are small and light in colour and do not differ much from the kulan in general behaviour. This proves that they are not an independent species, as was once thought, but merely a geographical race. In other countries too the Asiatic ass forms special geographical races.

The **Kainj** is a wild ass found in the high Tibetan mountains and was first described by Przewalsky. It is the mountain form of the Asiatic ass. According to Ellerman and Morrison-Scott the Kainj

Onager

inhabits Ladak, Nepal, Sikkim and Tibet up to the region of Lake Koko-nor. It has long ears, an ugly squarish head, and is somewhat bigger than the kulan. The most recent research has shown that the kainj differs in a number of ways from the chigetai and onager so it may well be an independent species.

The third and last group of the Equidae family is the horse. Everybody knows what a horse looks like whatever breed it may be. It is quite different form the zebra and nobody could possibly mistake one for an ass. In the first place horses have much shorter ears. Secondly the hair on their tails grows from the root.

The true wild horses inhabited only Europe and Asia. In the New World their ancestors died out in the Tertiary period. The horses now found in America are the descendants of animals that arrived there after the continent was discovered by Columbus.

Everybody knows the horse as a domestic animal, but few realise that there is a truly wild species living in Asia. It is **Przewalsky's Horse,** one of the several ancestors of the domestic horse. Przewalsky's horse is a small, sturdy animal with a big head. In summer its coat is red and brown or yellow and brown. In winter its fur is much longer and is greyish-brown in colour. The mane is always straight. In Przewalsky's horse the hair at the root of the tail grows from the sides; in the case of the domestic horse it grows right round the whole root of the tail.

Przewalsky's horse stands between 4 and $4^3/_4$ feet high at the shoulder and measures between 4 and 9 feet in length. On its legs there is often a suggestion of dark striping. The lower part of the limbs is dark. A dark stripe runs along the entire length of the back.

This is the last of the wild horses and its history has been most interesting. Przewalsky, the famous Russian traveller, noticed this horse on his travels in 1879. He brought home a skin and a skull which the zoologist Poljakov realised belonged to no known species. He described the skin and skull in 1881 and started an immediate dispute among zoologists. Some of them maintained that Przewalsky's horse was nothing more than a cross between the domestic Mongolian horse and the wild kulan, while others considered it no more than a gone-wild domestic horse. Then in 1907 a number of horses were caught up, some of which were taken to England and put in the Duke of Bedford's estate at Woburn. Several colts as well as hides and skulls also reached Leningrad, where Zelenskij wrote a special report on them. The colts which were brought into captivity came from three areas in east and west Mongolia and were not all of the same colour. Some of Przewalsky's horses were brought to the Ukraine and some were taken to Germany by Hagenbeck and Ruhe. The animals kept in the Prague Zoological Garden interbred with domestic horses so that not a single thoroughbred was left.

The crosses between Przewalsky's horse and the domestic horse are fertile so that the two can be considered as close relatives and not as independent species. Przewalsky's horse can also interbreed with the ass but these crosses are sterile, as are mules and hinnies.

There are two colour phases in Przewalsky's horses. One of them is light brown with a reddish-brown dorsal stripe; the other one is dark brown with a bold

stripe on the back and dark extremities. The muzzle of the latter type is pale at the tip. The two phases differ in the structure of their skulls. The English zoologist Lydekker regards the light brown phase as the result of interbreeding with the domestic horse.

Reliable information on Przewalsky's horses in the wild state is extremely rare and was published in special magazines which can now be obtained only with great difficulty. Between 1892 and 1896 Grumm-Grzimail studied Przewalsky's horses in the wild state and wrote about them as follows:

"The wild horses living on the wilderness plains graze and visit watering places during the night only. After sunrise they return to their grazing areas and rest until sunset. In spring, after the foals have been born, the animals remain in one place. This is proved by the fact that I personally have found a place eighteen square yards in area covered with a thick layer of horse dung. The wild horses travel mostly in single file, especially when they are retreating from danger. When danger threatens, the leading stallion gallops away at the head of his herd, but this is only when there are no foals. If there are foals in a herd his behaviour is restless and he shows his alarm constantly. The wild horse neighs clearly and its voice is very similar to that of the domestic animal."

The same author describes the hunting of Przewalsky's horse.

"We have noted the behaviour of the stallion. As soon as he discovers something suspicious he signals to the whole group by snorting. The horses dash away immediately in single file, the stallion at their head closely followed by colts and mares. As long as the herd was galloping and had the hunters on its flank, the stallion remained at the side keeping the whole group on the chosen track by neighing and stamping his hoofs. As soon as the horses passed through the chain of hunters the leading stallion fell behind as a rear guard. It was amusing to see how he would urge on a colt unable to keep pace because its legs were not yet strong enough. When a colt falls behind the mare tries to encourage it by soft neighing, but when this fails she separates from the herd and stays behind to defend it, but the stallion will not stand this breach of discipline. He kicks the mare and forces her to rejoin the herd. Then he

Wild Horse in summer and winter coat

takes care of the colt himself. He pushes it, pulls it by the mane and encourages it by assaults and kicks.

"It is not easy for the small Mongolian horse to overtake the wild Przewalsky horse, so the hunters must have several reserve mounts if they are to succeed."

There are remnant herds of wild Przewalsky's horses living in the wilder parts of the Djungar steppes and wastelands on the Mongolian/Chinese frontier. According to Bannikov, reporting in 1959, the territory occupied by the horses was about 8,000 square miles at an altitude of 3,000—4,500 feet. Nobody knows how many of them still live in these remote, inaccessible regions. In 1959, Bannikov suggested a number of forty, but this is almost impossible to check for the territory is vast and inaccessible and the herds cross and recross between China and Mongolia. According to the latest reports from Mongolia, a herd of Przewalsky's horses numbering forty was seen in 1959 in the frontier region of southwest Mongolia.

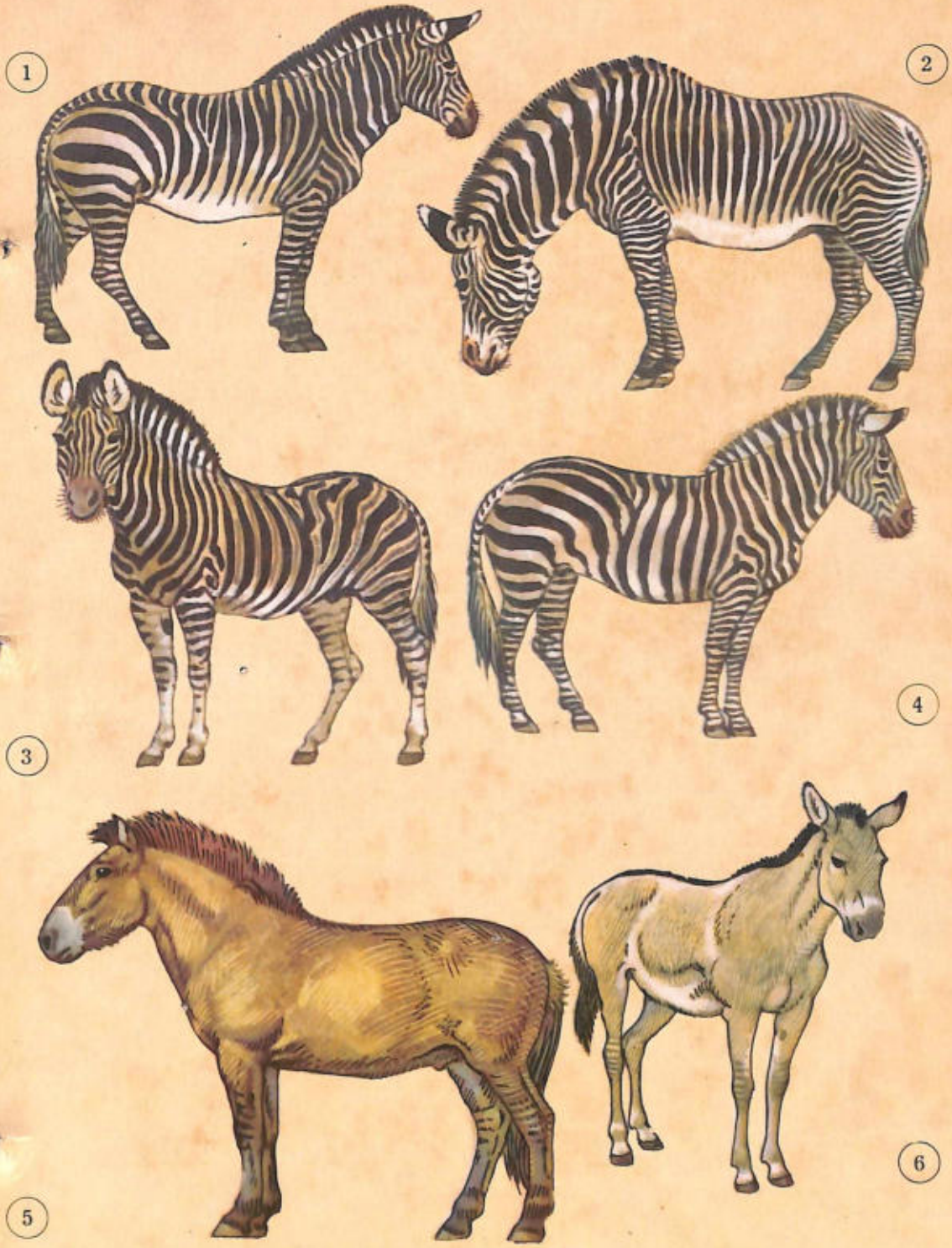
Future exploration may give us a more accurate idea about the numbers of wild horses in these little-known regions. Northwest China has remained practically inaccessible as far as the study of wild horses is concerned, and it may yet be found that there are more of them there than in Mongolia. In Mongolia and China the hunting of wild horses is now prohibited. Przewalsky's horse is a unique natural phenomenon and will only be saved by the establishment of reservations.

The **European Wild Horse,** or **Tarpan,** has been completely exterminated. It differed from Przewalsky's horse in being mouse-grey in colour, but resembled it by having dark legs and a dark dorsal stripe. Quite frequently the legs of the tarpan were cross-striped like those of the zebra. Like the true wild horse the tarpans had a short, upright mane. It is an interesting fact that descendants of gone-wild horses, for example, the American mustangs, never develop an upright mane. All of them retain the long, loose mane which is the sure sign of the domesticated animal.

The last refuge of the European wild horse was the South Russian steppe and the vicinity of the Dnieper River. Before that the tarpans had also been found in Poland and in the Baltic countries. There is no doubt that the domestication of the tarpan produced a small, wiry race of domestic horse. At the beginning of the last century tarpans could be seen in great numbers in the Ukraine. They caused a great deal of trouble to the local population, visiting the hay barns in winter and luring away the peasants' domestic mares which soon became wild. It is not to be wondered at that the Ukrainians hated the tarpans and killed them at every possible opportunity.

The scientists of that time could not agree about the origin of these horses. Some regarded them as truly wild animals while others insisted that they were the descendants of gone-wild domestic horses. While the scientists argued the peasants went on killing and the herds had almost disappeared before anybody thought of protecting them. Eventually, only two small herds remained and these included gone-wild domestic horses and cross-breeds. The last of the true tarpans was killed in the year 1876 by peasants and thus died the last of the true European wild horses.

No museum in the world has a single



X 1. *Mountain Zebra* 2. *Grevy's Zebra* 3. *Chapman's Zebra* 4. *Böhm's Zebra* 5. *Przewalsky's Horse* 6. *Asiatic Wild Ass*

specimen of a really genuine tarpan and the only living horse which still bears some resemblance to the old wild horse is the small **Polish Konic.** In an attempt to keep the tarpan type alive, Zamijski chose several stock animals from the Polish konics at the beginning of the last century. He bred only from types closely resembling the original tarpans. Between 1810 and 1815 he distributed some of these half-tamed animals among the local peasantry, who continued crossing them with domestic horses. To the present day they have retained some of the features of the wild tarpans and it was the most typical of these that the Polish zoologist Vetuljani placed in a reservation.

It seems that the tarpan is more closely related to the domestic horse than it is to Przewalsky's and this is confirmed by the fact that domestic mares would run off with tarpan herds whereas Przewalsky's horse did not mix with domestic breeds.

The **Domestic Horse** is one of the most important of all domestic animals and can safely be regarded as one of man's oldest helpers. We have trustworthy reports that the Chinese and Indians knew horses in the reign of the Emperor Fo-Hi in the year 3468 B.C. Most probably their domestic horses were obtained by taming Przewalsky's horse which was presumably common in Asia at that time. Even to-day some of the domestic horses in Northern China closely resemble the wild Przewalsky's. This was the type on which the Asiatic warriors were mounted when they invaded other regions of Asia and entered Europe. Skeletons of horses which have been dug up in the vicinity of Bratislava bear a striking resemblance to Przewalsky's horse.

European Wild Horse

In the Near East the domestic horse was probably evolved from the tarpan, which was slimmer than Przewalsky's and faster. Perhaps it was the ancestor of light riding horses of which the noblest and most notable is the Arab.

In West and Central Europe, the domestic horse had appeared at the beginning of the Bronze Age, that is in the seventeenth/eighteenth centuries B.C.

Excavations have shown that Europe was the home of heavy horses as far back as the Ice Age, and from these were later evolved the heavy domestic breeds, such as the Nordic, Danish, Kladruby and others. The modern Flemish horses, Shires and Clydesdales are other examples of heavy breeds.

All of them were used for hauling loads although nowadays they have been replaced in most parts of the word by machines.

Northern Europe also produced many small forms. These products of the rough northern climate were mostly long-haired, small in stature and big-headed, generally resembling more primitive types. These small, strong animals come under the general name of ponies. Several races of

these small horses still exist; the Iceland and Celtic types and the smallest of all, the Shetland Pony.

The domestic horse has been a faithful companion of man and has influenced human history to a significant extent. Without the help of the horse, civilisation would have developed at a much slower pace. The horse made possible the colonisation of new areas of the world by man and for a long time was the only means of transport available. It helped man to cultivate the earth, to remove forests, to build cities, to fight wars and to invade other countries. In many parts of the world its flesh was and is used as human food. Few people realise just how important the horse was to man, but it would not be too much to say that it was the most valuable domestic animal. Not even to-day, in the era of tractors and motor-cars, when horses have practically disappeared from the fields and the streets, can we say with certainty that its role as an important domestic animal is definitely over.

TAPIRS

Family TAPIRIDAE

Because of their stout, round bodies, Tapirs generally resemble pigs, but of course they are in no way related to the pig. Nor have they anything in common with elephants, although their upper lip is elongated into a soft, movable, short trunk. Their evolution shows that they are among the oldest living species on this planet. From the Tertiary period, when they were a widely distributed group, they have kept their appearance almost unchanged to the present day.

At the present day, tapirs are found only in East India, Sumatra, and Central and South America, although at one time they were also found in Europe, China and North America.

Tapirs have four toes on their front feet. The third toe is the important one as well as the strongest, and it has a well-developed hoof. The fourth toe, which might be compared with the human little toe, is placed higher than the other three and touches the ground only where the going is soft. The hind feet are three-toed and here the middle one is the best developed. On the inside of their forelegs, just under the elbow joint, the tapirs have a furless callous corresponding to the chestnuts in horses. On the soles of their feet they have an elastic callous pad similar to that found in elephants. The skull is remarkable for the protruding nasal bones which form the support for the short, mobile trunk. Something similar can be seen in the rhinoceros whose horns are placed on the elongated nostril bones. This feature proves the close relationship between the two groups. In tapirs there are four teeth in the upper jaw: three incisors and one eye-tooth. In the lower jaw there are only three teeth on each side, all molars. Young tapirs have light, lengthwise stripes similar to those of young wild pigs.

The **Brazilian Tapir** is uniform black and brown, or grey and brown, in colour, the head, chest and neck being paler than the rest of the body. It is found in South America, from Mexico to northern Argentina. Zoologists recognise four geo-

graphical races, differing from each other in size and colour. The fur colour of the South American tapir is changeable and quite definitely influenced by its environment. Even in zoos, tapirs of different colours can be seen.

The tapir's elongated lip or trunk is relatively short and it has a short tail. The Brazilian tapir measures up to $6^1/_2$ feet in length and stands about $3^1/_4$ feet tall, the females being much bigger than the males. Adult animals have a short mane.

Few zoologists have studied these shy and retiring animals in the wild state. Single animals, or small groups, are the rule. The tapir likes water, and is an accomplished swimmer, so is most usually found in areas which are frequently flooded. During the day, it lies up in thick cover and does not appear until dusk. It uses regular, well-trodden pathways through the forests. Its main necessities are water and food. Towards evening it will roll in the water and romp about as though in play. It is a vegetarian and feeds on the leaves of trees and bushes as well as on fruits and herbs. If there are fields or plantations in the vicinity it will eat cultivated plants as well. It is especially fond of salt and Rengger says that "in all low regions of Paraguay where the soil contains sodium sulphate and kitchen salt there are many tapirs to be seen. They lick soil which is soaked with salt."

Pregnancy lasts from 392 to 404 days, and the young are striped at birth. When the female is nursing her young she lies on her side like a nursing sow. The best developed senses are those of smell and hearing. Sight is not so good.

In South America, the jaguar is the main natural predator on the tapir. If the tapir is attacked by a jaguar it tries to get rid of its attacker by running through thick bush or plunging into the water. Besides being a good swimmer the tapir is an accomplished diver, and some zoologists say that it can walk for some distance on the bottom under the water as the hippopotamus can do. This has been confirmed by observations on tapirs in zoological gardens, yet, despite these abilities, many tapirs become victims of the jaguar. Tapirs killed by man frequently carry the marks of jaguar's claws.

A female tapir is fearless in defence of her young and fights stubbornly. In difficulties she will even use her teeth. According to Keller:

"The female tapir does not run away from barking dogs but remains bravely in her den protecting her young with her body. The young animals hide under her legs shivering and emitting shrill cries. Woe to any dog that has left the pack and approaches the fierce female alone. Under her short, upturned trunk her teeth can be seen. Many a dog gets its ribs broken between the tapir's mighty front paws."

Brazilian Tapir

Malayan Tapir

In Southern Brazil some progress has been made in taming tapirs and training them to carry loads, but it is unlikely that the animals will ever be used on a large scale. Their mental level is about that of the pig and nobody would dream of trying to tame and train pigs for any kind of work. Tapirs are said to reach the age of thirty years.

The **Andes Tapir** inhabits the high mountains of Ecuador, Colombia and Peru and is never seen below 10,000 feet above sea level. Like all animals living at high altitudes it has thick fur. It is smaller than the Brazilian species, not exceeding $2^1/_2$ feet in height at the shoulder. The Indians hunt it for its meat which is said to be very tasty, so it is scarce in some areas.

In the countries of Central America — Guatemala, Nicaragua, Panama and South Mexico — there are two other races of tapir. These were formerly classified in a separate genus because of certain peculiarities in the skeleton of their skull. They are *Tapirus bairdi* and *Tapirus dowi*.

The **Malayan Tapir** is found in Siam, Sumatra and the Malayan Peninsula. In general habits it resembles the Brazilian tapir but it is a much bigger animal measuring 8 feet in length and standing almost 3 feet tall. Mature adults sometimes reach a weight of over a ton. The Malayan species has no mane. It has a longer trunk and stronger legs than the Brazilian species. The head, neck, chest and forelegs are black to halfway up the hips. This broken colouring is unusual in mammals and cannot be easily explained.

This species inhabits lowland and mountain areas, but its numbers are slowly decreasing as its range becomes more and more restricted. In zoological gardens it is not so common as the Brazilian species.

RHINOCEROSES
Family RHINOCEROTIDAE

There are five species of rhinoceros alive to-day living in Asia and Africa. These are the last remnants of a group formerly represented by many species, some of which were found in North America.

Rhinoceroses are odd-toed mammals with three toes. The middle toe is the most highly developed and has the broadest hoof. There is an elastic pad on the sole of the foot similar to that found in elephants. The horn, for which the rhinoceroses are noted, is not made of bone or horn; it is a protuberance of the skin and consists of compressed fur-like fibres. Some species have two horns; others have only one. Rhinoceroses in zoos have been observed shedding their horns in the same way as stags shed their antlers,

but this happens only about once in ten years. New horns begin to grow again on the scar left by the old. In captivity, almost all rhinoceroses damage their horns by knocking against the iron and concrete of their cages, so some zoos remove them as a matter of policy.

All the rhinoceroses are stout, clumsy animals with a cylindrical body, short legs and a powerful head. The body is sparsely haired, mainly on the ears and tail. The skin, which is about one inch thick, is folded and in some species looks like armour-plating. In old paintings, the animals are usually depicted wearing armour like knights of the Middle Ages. The nose bone is elongated and has a bony pad forming the base of the horns. According to Bourdell, rhinoceroses vary in size as follows: Tip of muzzle to tip of tail, $7\frac{1}{2}$ to $14\frac{1}{2}$ feet; height at the shoulder, 4 to 6 feet, exceptionally up to $6\frac{1}{2}$ feet; weight from 12 to 40 hundredweights.

Rhinoceroses are territorial and remain on the same range throughout their lives. They have fixed trackways through the vegetation which they use when going to graze or to watering places. They have fixed dunging places and each beast has its own wallow. From time to time the animals scatter the dung with their horns.

The two lower incisors have developed into sharp tusks which are not visible when the mouth is open. When attacking, the African rhinoceros uses its horns. The other species use their tusks. All rhinoceroses have small eyes and their sight is weak. They are all vegetarians and feed mainly on leaves, twigs, root stalks, bulbs and grasses. They dig for underground storage organs with their horns.

The **Great Indian Rhinoceros** has a short, broad head and a single horn. The skin is divided into shields with folds on the shoulders and thighs. The skin of the body is loose so that the individual shields can move freely. The colour of this species is dark-brown and grey.

The first animals of this species were

Great Indian Rhinoceros

brought to Europe in the reign of the Roman Emperor Titus (A.D. 79—81), and for the second time at the beginning of the sixteenth century when they were painted by the famous German artist, Albrecht Dürer. About thirty animals in all were brought to Europe.

The great Indian rhinoceros, which was formerly found all over India, is now very rare. According to the latest statistics, there are still three hundred animals in Nepal, and another three hundred and fifty on five reservations in Assam. It is estimated that the total population of this species is now eight hundred animals. Only a few zoological gardens have one of these rare animals. They do not breed readily in captivity and only three cases of breeding have been recorded. One young Indian rhinoceros was born on shipboard between India and America, but it died shortly after birth. Another was born in the zoological garden in Basle on the 13th September, 1955. This specimen weighed over 130 pounds at a day old (the young of a two-horned rhinoceros weighed 55 pounds). In 1957, a young Indian rhinoceros was born in London Zoo. The life span of these rhinoceroses is known only for animals in captivity. One specimen, which had lived for thirty-eight years in the zoological gardens in Vienna, died when transported to Breslau. Another animal, which was brought to Hagenbeck's Menagerie in 1930 at the age of two years, lived there for twenty-six years. The greatest age recorded for an Indian rhinoceros in captivity is forty-one years.

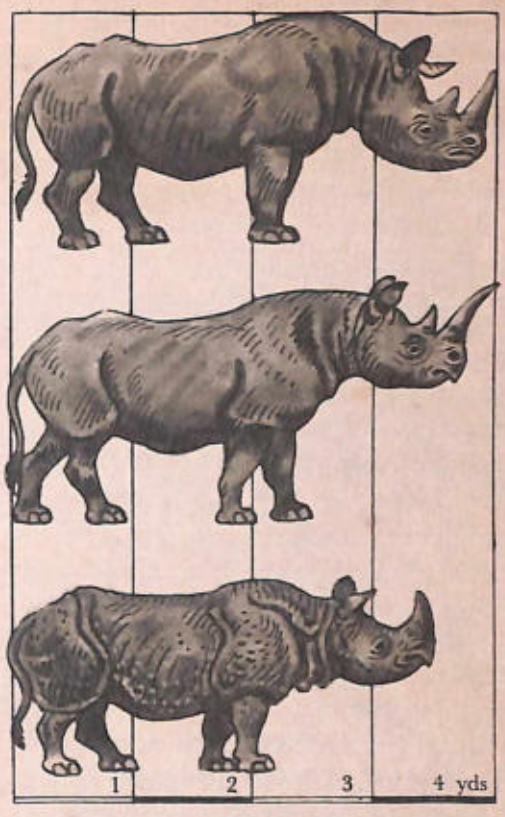
The **Javan Rhinoceros** resembles the great Indian rhinoceros but has a smaller head and a shorter horn. At one time, this species was found in Bengal, the Malay Peninsula, Sumatra and Java. A reservation was set aside for them in Burma in 1928, but this step was taken too late to save the species there. By 1932, it was believed that only one animal remained alive in the Malay Peninsula, and Mr. Hubback, the head English game warden, issued orders to kill it so that this last specimen of its kind might reach the British Museum for study. Many people did not agree with this, but we believe the decision was correct as this single animal could not breed.

In 1958, Dr. Grzimek caused a sensation when he cited a report in a Malayan newspaper, which read: "One-horned rhinoceros photographed for the first time in Malaya." The first photograph of this rarest of big animals was taken on the 14th March, 1958, by Monsieur Pierre Bazim in the Lima Blas Oil-palm estate, Slim River, Terak, Malaya. This was almost certainly the first photograph ever taken of a living Javan rhinoceros in Malay twenty-five years after the species was supposed to be extinct. The photograph, reproduced by Dr. Grzimek, shows the rhinoceros crossing a highway pursued by a farmer's dog. The existence of this animal now made it clear that the killing of the presumed last specimen in 1932 was a serious mistake. The species was exterminated in Sumatra in 1934. In Java, only twelve to fourteen animals remained on the Udjug-Kalon in 1955. Between 1946 and 1951, ten rhinoceroses were killed by poachers. Dr. Grzimek estimated that about twenty Javan rhinoceroses still remained alive in 1958.

The **Sumatran Rhinoceros** has two horns and is the smallest living species, measuring about $6^1/_2$ feet in length and standing $4^1/_2$ feet tall. Its whole body is

covered with black and brown bristles which are thickest on the nape and flanks.

At the end of the last century this species was still found in Assam, Borneo, Sumatra and the whole of the Malay Peninsula. We do not know how many remain alive in Malaya or Assam, but they still exist there, especially in mountain areas. They are in greatest danger of extinction in Borneo and Sumatra, where they are hunted by both natives and white men. There are one or two animals left in Sarawak and only a few elsewhere in Borneo. The American, Talbot, found few traces of this species in 1954/55 on reservations. There are only ten of these small rhinoceroses alive on the two islands to-day. Latest reports from the well-known hunter, Peter Ryhiner, indicate that only forty to sixty Javan rhinoceroses remain alive in Sumatra, along the Siak river. It is quite obvious that the rhinoceroses of Asia are in great danger of extinction.



Relative sizes of rhinoceroses (from top to bottom): White, Black and Great Indian Rhinoceros

African rhinoceroses are still in a stronger position. The best known of these is the **Black Rhinoceros,** which is really dark-grey in colour and not black as its name implies. Adult males of this species measure $11^1/_2$ feet in length from the tip of the muzzle to the tip of the tail. The tail is $27^1/_2$ inches in length. The black rhinoceros stands about $5^1/_2$ feet at the shoulder and weighs between 19 and 25 hundredweights. It has two horns, small, round nostrils, and an elongated, prehensile upper lip. The prehensile lip indicates that this species is a browser. It feeds on the twigs of bushes and on leaves, gathering them up with its lip and plucking them off.

The front horn measures from $27^1/_2$ to $31^1/_2$ inches in length. Longer horns are rare. Horns are found in both sexes, but those of the female are thinner.

This species once ranged over a vast area, but it has been almost exterminated in South Africa where only a few specimens still remain alive in the Umfolozi reservation. They are extinct in the Kruger National Park and in the Congolese Republic. In French West Africa, their present number is estimated at between 500 and 1,000 animals. The species is commonest to-day in Kenya and Tanganyika. In recent years, the Tanganyikan Game department has killed about 1,200 animals in the interests of the native population. According to Dr. Grzi-

mek, the rhinoceros population of East Africa is constantly over-estimated, with the result that shooting is too heavy, despite being regulated by law.

During a recent survey, carried out over a period of some weeks from a low-flying aircraft, only fifty-four rhinoceroses were counted on the 6,000 square mile Serengeti National Park. In 1960, Dr. Grzimek estimated that only 6,000 or 7,000 black rhinoceroses remained on the whole continent of Africa. The idea of protecting wildlife took root in Africa earlier than in Asia, so that African rhinoceroses are not so seriously threatened as their Asiatic relatives. Many reserves have been established in Africa where hunting is regulated, but it is still very difficult to estimate how many animals remain alive. In 1958, the number was estimated at 10,000. Even if this figure were correct, the number is not great considering the vastness of Africa.

The Czechoslovakian zoologist Dr. George Baum, writes:

"The inhabitants of Cape Town nowadays know the rhinoceros only from Johnson's films, and not even the zoological garden can boast a single specimen. The rhinoceroses disappeared from the vicinity of this town a long time ago, but people still talk about Governor Van der Stel, who went for a walk in the vicinity of the town and met a rhinoceros from which he escaped with great difficulty. This now sounds like a fairy tale. In the eighteenth century, Dr. Kolb shot one hundred and fifty rhinoceroses in South Africa. He wounded the one hundred and fifty-first animal and was killed by it. Count Teleki killed ninety-nine rhinoceroses during a single expedition and discovered Rudolph's Lake at the same time. An English hunter, named Hunter, who lives in Africa, boasts that he has shot one thousand rhinoceroses."

Although rhinoceroses are irritable and can be dangerous, they were not killed for this reason but mainly for their horns, because people used to believe that the horn was a protection against poisons. If a poisoned drink was poured into a cup made of rhinoceros horn it boiled up and effervesced. Such was the belief. The demand for rhinoceros horn slackened off, then increased again for another reason. This time the market lay in the Far East, the orders coming from China. The second boom began in the year 1927 and the value of horns began to rise quickly. This was the result of a belief, for which there is no foundation, that powdered rhinoceros horn is an aphrodisiac. By 1939, merchants in French Equatorial Africa were paying two hundred francs for 2 pounds. Naturally, such profits were attractive to the poor Negroes and, in spite of all the protection measures of the Colonial governments, the rhinoceroses were exterminated almost everywhere and survived only in inaccessible regions, or in areas infested by the tsetse fly. One Indian business man was arrested by the authorities after his hunters had killed six hundred rhinoceroses.

There is no great art in killing a rhinoceros, although much nonsense used to be talked about the animal's invulnerability. While it is true that its skin is very hard it is not proof against a bullet fired from a modern rifle. Hunters usually aim at a spot near the base of the ear where the bullet kills instantaneously. Even the spears and arrows of the natives can penetrate the animal's hide if they are thrown from close quarters. The rhinoceros has poor vision, so if the wind is blowing from the animal towards the

Black Rhinoceros

hunter it is quite easy for the hunter to make a close approach. The sense of smell, on the other hand, is excellent.

Machulka says that on his expeditions rhinoceroses were seldom killed, but he has given some interesting details about them:

"The Black rhinoceros is readily irritated by any suspicious sound or smell, especially in places where it is frequently disturbed or hunted. Its vision is most probably very weak for it cannot distinguish an object even at a short distance; therefore it tries to remove the cause of the disturbance by attacking. Six of us, five Europeans and a Negro, were standing only a few paces from a rhinoceros which had been facing us for a very long time. We were standing quite motionless. The animal was shuffling from one foot to another, but it could not distinguish what it was looking at. In the end, it snorted, twisted its tail and disappeared. This was as well for the animal, because its attacks are of little avail against modern weapons."

Filming rhinoceroses can sometimes be dangerous because animals have been known to attack the car carrying the cameras, but if the animal is in a good temper it is sometimes possible to approach it very closely without danger. Dr. Ullrich has described such a case:

"I was busy with my exposure meter when Ernst, who was spying the surroundings, called out that a rhinoceros had appeared. We approached at a slow speed until we were within fifty yards of the animal, which turned out to be a female with her young. The female has an incredibly long horn which protrudes forward for about 3 feet, but the young animal too had a special feature. It had only half a tail and one ear was missing. Perhaps it had been attacked while still very young by these terrible marauders of the plains — the Hyena Dogs. These dogs tear the victim to pieces. I could not lose this unique opportunity. We approached to within thirty-five yards.

"The female is standing still, looking in my direction, nodding her head to and

fro. Her tail is raised in excitement. According to many big game hunters, this is a very bad sign. I hold my breath and start up the camera. If I can avoid camera shake, this is going to be a wonderful film sequence. The rhinoceros becomes bigger and bigger in the camera viewfinder. I move closer until only the front half of her body can be seen, then closer still until her head and neck fill the frame. Her long horn is now out of the picture. I am now thirty feet from the animal. I take my last portrait of the mother, then follow the pair for about fifty feet until they disappear in the bushes. My film is running out. I wipe the perspiration from my forehead. It is hard work filming a rhinoceros."

In its habits, the rhinoceros is mostly nocturnal, lying up during the day among acacia bushes and coming out at night to feed. It is an animal of fixed and regular habits. It is fond of water and will travel long distances to reach it. It likes to swim or wallow in the mud. It is frequently accompanied by oscine birds, which climb all over it like woodpeckers and remove parasites from its body. These birds are a great help to the rhinoceros because they can spot danger long before the animal becomes aware of it.

This species is often seen in zoological gardens. One animal, called Max, which was placed in a zoo after four years in a circus, was described by Dr. Baum as "a grouser, a being not fond of company and with an old bachelor's nature. It dislikes the whole world, but especially people, and is friendly only with its keeper."

The **White Rhinoceros** is the second largest land mammal, the biggest being of course the elephant. This rhinoceros can reach a weight of three tons and some reach a height of 8 feet at the shoulder. It has two horns. The front one reaches a length of $4^{3}/_{4}$ feet and the greatest length recorded is 5 feet $2^{1}/_{4}$ inches for the northern race. The skin is naked and grey but a little lighter in colour than in the black rhinoceros. In both species, colour is largely a matter of the colour of the mud in which they have been wallowing, and the name, White, used for this species, is likely to be a corruption of the Afrikaans word *weit,* meaning wide. This refers to the broad, square-lipped mouth of this species, which is diagnostic and has nothing to do with colour. Another feature which distinguishes it from the black rhinoceros is its long head and the great hump between its shoulders.

Machulka writes of the white rhinoceros:

"The difference between the white and black rhinoceros is not of course in their colouring. In both species the colour of the skin is grey, as in the elephant. Their colour at any time takes after the region in which they live — in other words, the colour of the dust or the mud in which they are incessantly rolling. A great deal also depends on whether the mud is dry or wet. Either species can appear red, black or grey. The white rhinoceros is bigger than the black and has a large hump on its shoulder blades which grows larger when the animal lifts its head. When excited it raises its head to the horizontal position. At all other times it carries its head low. When watching these animals I have always had the impression that they were looking for, or smelling at, something on the ground. The black rhinoceros, on the other hand, always carries its head in line with its back. The

head of the white species is much longer than that of the black and is squarer in shape. Its broad, rectangular upper lip is also very noticeable, indicating that this species is a grazer. In fact, it feeds almost entirely on grasses.

"The traces of the two species are similar, but the dung is quite different; that of the white rhinoceros resembles horse dung, while that of the black is similar to the elephant's and is full of woody fibres from undigested twigs. Both pile their dung in front of a bush, then scatter it over the bush with their hind feet. Both species mark trees with their urine and will use the same trees for long periods. Such marking places, viewed from a distance, appear to be whitewashed.

"The white and black are temperamentally different. The black will attack when provoked or irritated, but the white is usually a quiet, subdued animal. Because of this it can be observed at close quarters, or tracked without fear."

The white rhinoceros was never as widely distributed in Africa as the black and is thought to have been confined to South Africa. In 1910, there were only ten specimens on one South African reservation. Protection helped the species and the number of animals in this reserve is now 600. The Northern race of the species, inhabiting the west coast of the Nile and the Southern Sudan, was discovered about the time the white had been almost exterminated — that is, at the beginning of the present century. Estimates of populations to-day are:

White Rhinoceros

Umfolosi Reservation	600
Uganda	335
Congolese Republic (Garamba Reservation)	700

Dr. Grzimek reckons that there are probably 2,000 white rhinoceroses left in the whole of Africa.

White rhinoceroses are seldom seen in zoological gardens. There was one in Pretoria, and Antwerp Zoo had two.

ORDER: ARTIODACTYLA

This is the order of even-toed ungulates. We have seen that the odd-toed ungulates place the weight of their body on only one toe, which is provided with a hoof. The even-toed ungulates place their weight on two toes. The axis of the leg does not pass through any one toe, it passes betwen the third and fourth toes, which resemble each other in shape and size and correspond to the middle and ring fingers of the human hand. The other toes are either vestigial or completely absent in the majority of animals in this order. Where the second and fifth toes are developed, they are placed high on the foot and do not touch the ground at any time. An exception to this rule is the hippopotamus.

Unlike the odd-toed ungulates, this order has a complicated digestive system and the ruminants have a four-chambered stomach and a special system of regurgitation, known as chewing the cud. Herbal food is digested with difficulty and must be properly masticated and pass through a long digestion process before it can be used to nourish the tissues. Because of this, the stomach is much more complicated than in other mammals. All even-toed ungulates, especially the ruminants, have extraordinarly long bowels; and in cows the bowel is twenty times longer than the body, whereas in a carnivore, like a dog, it is only five times longer. In the case of the giraffe, the digestive system is 88 feet long and in deer, 124 feet.

The teeth of the even-toed ungulates are never complete. The molars have powerful grinding surfaces provided with round, or halfmoon-shaped protuberances.

The even-toed ungulates are gregarious animals which live in groups or herds, and they have strongly developed scent glands between their hoofs. The secretions from these help the animals to keep in touch with each other. They also help to reduce friction between the hoofs when the animal is walking or running. Milk glands in the shape of udders are situated mostly between the hind legs and are provided with two or four teats. An exception is the pig which has a number of teats from chest to abdomen.

The young of the even-toed ungulates are born perfectly formed and are able to follow their mother within a few hours of birth. In many cases they are differently coloured from their parents. Many of them are born with lengthwise stripes or spots, whereas the adults are usually of a single colour.

In this order are many animals which differ from each other in external appearance and in their structure. It is obvious that the hippopotamus, pig, cow, and the stag bear very little superficial resemblance to each other. Nevertheless, certain features of the skull and the skeleton show a close relationship, indicating that these animals had common ancestors in past geological ages. The diversity of form evolved over a long period, influenced by different environments and ways of life.

Even-toed ungulates are found in all continents with the exception of Australasia, but deer were imported into New Zealand and are now well established there. According to Simpson, there are eighty-six families of even-toed ungulates still in existence. In this book, we classify the even-toed ungulates into two sub-orders, the Ruminants and the Nonruminants.

NON RUMINANTS

The families of this suborder are the pigs and the hippopotamuses, which differ from the other even-toed ungulates in having simpler stomachs. Nevertheless, the stomach of the non-ruminants is different from that of other mammals, forming a sort of transition between the simple stomach of most mammals and the complicated stomach of the ruminants. Close examination of the non-ruminant stomach reveals that it is divided into several parts, the inner walls of which have different structures. The second and fifth toe of the non-ruminants is better developed than that of the ruminants. The incisors of the lower jaw protrude horizontally forward, the molars are wide and strikingly low and have many protuberances. The eye teeth are powerfully developed and turn upwards. Most species in this suborder are covered with bristle-like hairs, but the skin of the hippopotamuses is naked.

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OLD WORLD PIGS
Family SUIDAE

Pigs of all species and types resemble each other in outward appearance and generally resemble the wild boar. Domestic pigs, selectively bred by man, have sleek barrel-shaped bodies, but are none-the-less obviously pigs. Wild pigs of all kinds are rather more slab-sided. The conical head is elongated into the well-known pig's snout which ends in a large, fleshy, sensitive disc in which the nostrils are situated. The strong muscles of the upper jaw enable pigs to find their food by rooting. The number of incisor teeth is not constant. In the upper jaw there are one to three, in the molar jaw two or three. In old age the teeth fall out. The eye teeth are especially powerful. They are three edged and when fully grown can become very dangerous weapons. Only the front molars are pointed.

Pigs eat almost anything — edible roots, bulbs, fruit, mushrooms, insects, larvae, worms, molluscs, snakes, young birds, mice, moles and carrion. They become adult in the second year of their life and are prolific breeders. Litters of up to twenty-four young have been recorded. Domestic pigs breed at a much earlier age and are also prolific. Sows have, therefore, many teats in two parallel rows on the chest and abdomen. Wild pigs have been able to withstand human hunting pressure because of their high reproduction rate.

Most people think of pigs as clumsy or lazy animals. In fact, they are active animals with well-developed senses, especially the senses of hearing and smell. Despite their short, slim legs they can move at speed, even in the thickest undergrowth. Nor are they afraid of deep water. They are excellent swimmers and have been known to swim across bays and straits.

Wild pigs are found in all parts of the world with the exception of Australia and most of North America. They like wet forests and are fond of water. They could live without rivers or brooks, but not without muddy places and shallow waters. They like to wallow to keep cool and therefore favour such places. They forage at dusk and are always found in small groups. Only old boars are solitary and unsociable.

The **European Wild Boar** is the only species found in Europe. It stands taller than the domestic pig and its head is more elongated. Although variable in colour it is usually black and brown. For this reason it is often referred to by Continental gamekeepers as "black game".

Adult wild boars measure up to 6 feet in length, including a tail of about 10 inches. Slovakian wild boars are considered to be the strongest in Europe. Adult boars weigh from 330 to 440 pounds, but very old boars of 660 pounds have been killed. There is a Far Eastern race living in the basin of the Amur and Ussuri, some members of which weigh up to 704 pounds. Wild boars from Western Europe, especially those of the Mediterranean islands, are much lighter in weight.

Like so many other mammals, the wild boar was once more widely distributed and found in far greater numbers than it is to-day. Formerly, it inhabited the whole of Europe, Asia and North America, but it was persecuted wherever man cultivated the ground because of the destruction it caused in fields. It has disappeared from Great Britain, Denmark and the Scandinavian countries. In the Swiss Alps it is seen only when animals cross the frontier from neighbouring countries and Swiss gamekeepers are always on the lookout for such invaders. The species was exterminated in Bohemia and Moravia. Professor Fric states that the last wild boar in Bohemia was killed in 1801. It is an interesting fact that the bear, the lynx, and the wildcat were exterminated in Bohemia much later than the wild pig. In Great Britain, the wild pig became extinct early in the seventeenth century, long after the extermination of the bear and a century earlier than the wolf. It was, apparently, never found in Ireland, a country now noted for the quality of its pigs.

Old records give some idea of the once great numbers of these animals. In 1782, two thousand boars were killed during a hunt organised by the Duke of Würtenburg. The nobility established preserves for wild boars in the nineteenth century. They imported wild pigs which had to be artificially fed. In the vast forests of Slovakia, wild boars are common to this day. Although they are now found mostly in hilly and mountain regions, their original habitat was the wet, boggy, lowland forests. After the Second World War, wild pigs increased in numbers in Poland and Germany to such an extent that they became a menace in arable fields. As a result of this, there was further colonising across the frontiers into the mountains of Czechoslovakia.

Although wild pigs at first sight appear to be slow-moving animals, they can in fact move with extraordinary speed. They are great travellers and adults will cover twenty or more miles in a night. During their travels they swim across great rivers and, under cover of darkness, will cross vast unforested areas. In the year 1957, three wild boars appeared in Prague. Two of them found their way into the river bed and could not find their way out because of the high embankments. The exhausted animals were pursued in boats and, finally, shot by gamekeepers. In Bohemia, the animals have a close season from 1st of March to the 30th September.

Gamekeepers and farmers differ in their estimate of the wild boar's harmfulness, or usefulness. There is no doubt that it can be destructive in fields, where it destroys more crops by crushing than by eating, and if a group visits the field of a poor farmer the devastation they

leave behind can be crippling. In forests, however, the animals are entirely useful. They destroy many harmful insects, for example the pine moth hibernating under the litter or in moss. The wild boars root them out and eat them. Gamekeepers point out that the pigs by their incessant burrowing in leafy forests help natural regeneration of trees. The late Professor Komarek drew attention to this important fact many times. The wild pigs also destroy many field and forest rodents whose harmfulness to man cannot be accurately measured.

Most people think of the wild boar as a treacherous, dangerous animal, and tourists visiting parts of Europe where wild pigs are found are usually afraid of meeting one. All such fears are groundless because the wild boar does its best to keep out of man's way at all times. Although it has poor eyesight it can smell a man at a distance of five hundred paces, so it usually able to move away before it is seen. Tourists who do meet up with wild boars need do no more than clap their hands to drive away the whole herd.

Of course, it is quite a different story if a hunter wounds an old boar or tries to take a little, striped piglet from a wild sow. A wounded boar will attack a man with great savagery, using its tusks with deadly effect, but this happens very rarely. The facts are clearly set out by Professor Komarek, an experienced hunter, who frequently hunted the wild boars of the Carpathian mountains:

"It is time we evaluated properly what hunters have referred to as the wild boar's bravery. In the yarns told by the hunters there are many descriptions telling us about brave wild boars and timid hunters, so that anyone not familiar with the wild pigs might well wonder what the true facts are. Let us leave all the hunters' yarns aside and I shall tell you what has happened to me, and what I have witnessed myself. The dangerous moments during a hunter's encounter with a wild boar are mostly brought about by the hunter himself and by bad shooting. I have shot many wild pigs and seen many more killed by several hunters, but the exciting moments were so rare that I could count them on the fingers of one hand. Obviously the wild boar can become aggressive under certain circumstances, even if not wounded by

Wild Boar family

man; and it is a well known fact, established by long experience, that a wild sow will defend her young with great bravery. This does not mean, however, that she attacks a man as soon as she sees one, far from it. But she regards man as her greatest enemy, as he is. So, when she comes upon one suddenly, she becomes excited and rushes against him, snorting and grunting with her snout close to the ground. This is usually the full extent of her attack. The little ones, in the meantime, have hidden themselves or run away, and the mother, after frightening off the enemy, follows her young.

"In similar fashion, a wild sow will attack a dog, even when the dog is accompanied by a man. The man who does not know the habits of the wild pig thinks the sow is attacking him and makes use of his gun, quite without cause. I know of no case where a wild sow leading young has made an attack directly on the body of a man, with the exception of the case which happened to me personally. But this happened under special circumstances. Some time ago I was riding on horseback through the vast, reedy area near the banks of the river which forms the boundary between Russia and Persia. I let the horse gallop on the soft path. Suddenly the horse was surrounded by animals of brown colour, about the size of a badger-dog. Before I could stop the horse it had trampled down one of the animals, which started squealing shrilly. The animals were small wild boars which had run out of the reeds. The horse shied and then started to gallop, but the wild sow did not let it go without argument. She ran for a considerable distance alongside the horse, despite the fact that I was beating her with my whip. Then she suddenly disappeared into the reeds as quickly as she had appeared. It was possible that the attack was not intended for me but for my horse.

"A wounded wild boar will attack only under special circumstances; even the strongest animal, when badly wounded and trying to escape to save its life, will run away from the hunter. This it will always do if it is able to do so. It does not realise that it is fatally wounded; on the contrary it is convinced that it can run away. The attack of a wild boar is extraordinarily swift. Usually one barely has time to give it the last shot before it is at one's feet."

Hunting wild boars is not an experience which the hunter forgets quickly, and in his book, *Hunting in the Carpathian Mountains,* Dr. Komarek has given us some exciting descriptions:

"Boar hunts were so common that it was possible to take part in two or three of them in one day. The beaters as well as the hunters were dressed as though for the Arctic, because the hunters especially had often to stand still in deep snow, when the temperature was about 20°C. and there was an icy wind blowing up the mountainside. Everyone was listening expectantly for any sound that might betray the pigs in the deep silence of the wintry forest. Sometimes one could hear dry rustling in the distance where the pigs were moving in deep snow; sometimes the hunters waited in vain. Finally, you could hear the voices of the beaters in the distance. Suddenly a shot would be fired which echoed across the valley and, in a short time, the hunter would see on the slope a cloud of snow billowing round the dark bodies of the wild pigs. Then you would hear the gun of your neighbour and, suddenly, a wild black boar was passing in front of you like some

fierce forest monster. Sometimes a hunter would be warming his hands on his bottle of hot tea when the boar appeared without warning. The wild boar would stand like a statue, surveying its surroundings. The hunter would put down his bottle of tea with the greatest care and lift the gun, inch by inch, on to his shoulder. Then, just as he was about to pull the trigger, the black giant would turn and move and the shot would miss its target.

"The eye teeth of the wild boar are powerfully developed, especially in the case of older animals. The upper eye teeth turn upwards from the jaw and they are only half the length of the lower eye teeth, which are sharp, pointed and serve as deadly rending weapons. The animal thrusts these into its enemy and by pushing upwards with them causes terrible wounds. The best developed senses of the wild boar are smell, hearing, touch and taste; sight is very poor. But it sometimes happens that the boar's senses fail it. I had experience of this once during a stag hunt.

"The rut was over and the stags had stopped roaring. One night I was returning from a stag hunt to the hunter's cabin. On such occasions I wear soft sports shoes with foam rubber soles so that I can move quietly when approaching game. The sun had long since set. I could still see objects in the leafy undergrowth, but when I entered some fir trees I could hardly make out even the closest of them. Suddenly, I heard stamping of feet on my right and I stopped automatically. Then, one hundred feet to my right I could see one, two, three, twelve dark forms — wild boars! But how was I to see to shoot at them? The whole group was running uphill among beech trees. Presently, the moon would appear, so what if I were to follow the boars right up into the light forest and the peak? Perhaps the moonlight would be good enough to shoot by. I followed the boars as silently as my shadow and, presently, was able to witness a scene to excite any hunter.

"For thirty minutes I followed the pigs, which were squealing and snuffling and pulling roots out of the ground. I approached them, step by step, with the utmost care. The wind was favourable, blowing from the boars towards me. Because of this, and because of the noise they were making, I was able to follow the group closely. I have to confess that my blood was racing in my veins, not because I was afraid, but because I was wondering how this would all turn out in the end. In the event the group suddenly scattered, and I found myself right in the middle of them. The boars were in front of me, behind me, and on the right and left of me. I could see their dark forms everywhere. For a while I leaned against the trunk of an old beech tree. About twenty feet away on the left, one of the boars was scratching itself against the trunk of a young fir and I could see the tree shaking. There were many boars in the herd, perhaps twenty, or even more, their dark forms of various sizes. It was obvious that the group contained several families with young of different ages.

"I cannot understand even now why not a single boar discovered me during the whole time. The thrilling adventure continued. We got to the edge where there were clumps of beech trees on the edge of the forest. The moon was shining. I was waiting behind the trunk of a beech tree wondering if some of the animals would appear in a glade about

fifty yards away. My heart was beating more and more vigorously.

"Suddenly, in the moonlit glade, there appeared two silvery shapes. In the gun's telescope I could see two bodies of approximately the same size. My shot caused panic among the boars. They ran in all directions and before the echo of the shot had died away the animals had disappeared and their stamping could no longer be heard. I had marked the place where the boar had been standing and went to fetch a lamp from the cabin. However, we could not find the animal in the poor light and I slept very badly that night, wondering if I had wounded the boar or missed altogether. Most of all, I was afraid that I had wounded it, but I was convinced that the shot had been a good one. At dawn I found a pool of blood near the place I had marked and knew that my shot had been a good one. Fifty yards or so away, lying against the trunk of a fir tree, I found the dead boar shot through the heart. He weighed 176 pounds. Several of my guests, who had taken part in the hunt enjoyed the good goulash which I prepared before my departure."

The voice of the wild boar is similar to the grunting and squealing of domestic pigs. The wild pigs mate from November to January, and after sixteen to twenty weeks the sow gives birth to her litter of three to twelve young in a den littered with moss. The young are striped at birth. The boars are sexually mature in their second year but grow on until they are five or six years old. If the wild pig escapes the hunter's bullets it can reach the age of ten or twelve years.

In East Asia, India and the Malayan Archipelago, in Taiwan and Japan, there are many striped boars of this species to be found, but the various forms do not differ much and present-day zoologists regard them as geographical races of the European wild boar. Whether they are races or different species is difficult to say.

The **Crowned Boar** derives its name from the white stripe on the sides of its head and on its cheeks. It is a comparatively slim animal with long legs and is found in Java and Sumatra. This is the species from which the domestic pigs of South Asia have been evolved. The domestic pigs of China and Japan derive from the Chinese pig and the Japanese pig. From this it can be seen that domestic races, like the English, Hungarian and Mongolian pigs, do not have common ancestors. European pigs are for the most part descended from the European wild boar, whereas in Asia we have to look for the ancestors of the domestic pigs from the wild races found there. It is now generally agreed that in Scotland the wild boar was long ago domesticated and provided the original domestic pig there.

Experts on domestic animals are now of the opinion that the modern domestic pig evolved from four sources; two in Europe, one in the Near East and one in China. Man tamed many wild races and evolved the present-day domestic pig by cross breeding and improving those types which made quick growth and laid on plenty of body fat. Pigs are, of course, reared mainly for their meat and fat and their usefulness has been exploited by man for many centuries. There is plenty of evidence that man was raising pigs in the New Stone Age.

The **Pygmy Hog** is a pygmy among wild pigs. It is found among the forests

and grassy jungles in the foothills of the Himalayan mountains — Nepal, Sikkim and Assam. It measures only $22^3/_4$ inches in length.

One of the most beautifully coloured wild pigs is the **Bush Pig,** which is smaller than the European wild boar. It is brown and yellow, or red and yellow, with black forehead, crown, ears and legs. The edges of the ears, the narrow stripe on the back, the area round the eyes and the top of the snout are pale-coloured or even white. The mouth and the lower body are grey and black. The ears are long and sharp pointed and the animal has pronounced whiskers and a short mane. The bush pig inhabits Africa, from Cape Province up to Guinea and Somalia in the east. It is found in lowland and mountain forests.

A close relative of this species, the **Madagascar Pig** is found in Madagascar.

From the great number of African pigs, we chose a few representative species. One of these is the **Giant Forest Hog,** which was discovered only at the beginning of this century. Machulka has described it as follows:

"This hog remained something of a mystery for a long time. Many wild stories were told about it, one of which said that it was as big as a rhinoceros. In fact, it is a long way short of this size. In the darkness of the forest it may seem a real giant because its stout body is covered with long, black, rough bristles, measuring up to $7^3/_4$ inches in length. These bristles stand erect like the bristles of a brush. The giant forest hog walks with its head held low. If the animal is excited in any way it raises its head. When this happens, high folds of skin

Bush Pig

appear behind the head and the bristles stand erect, so that in the darkness of the forest the pig looks like some great and terrible monster. Its general appearance fosters this impression because the head is extraordinarily long and powerful in relation to the body size and ends in a big wide snout. The adult males have large warts under their eyes giving them a wild appearance. In fact, the giant forest hog is neither horrible nor dangerous and can be regarded as more or less harmless. My impression of this hog is that of a poor creature with toothache, inflamed gums and swollen cheeks.

"The giant forest hog feeds mostly on leaves, young sprouts of plants and on fruit. Despite its large snout, it does not burrow in the earth and I found no traces of burrowing on any of the forest paths used by this animal. However, it does considerable damage in the fields. It is a nocturnal forager and can be encountered during its visits to the villages or to salt licks. It is found mainly in the jungles of Central Africa and locally in the jungles of East Africa. The species can be regarded as a transitional type between the pigs of the family Sus and the wart-hogs."

Wart-hog

The **Wart-hog** has all the appearances of a monster and measures from $25^1/_2$ to $32^1/_2$ inches from the ground to the crown of its head. Sows never exceed 29 inches. The body measures $6^1/_4$ feet in length, of which $17^3/_4$ inches is tail. The body is not flattened at the sides as in other wild pigs but is cylindrical, with a sag in the middle of the back. The head is big and square and the snout broad with four warty protuberances on the sides. The small eyes are almost hidden by special skin folds. The body is sparsely bristled but there is a mane of bristles covering the neck and back. The general colour is grey. The males have large tusks protruding upwards from their mouths and use them for burrowing into the ground and tearing out roots. Wart-hogs have hard callouses on their knees because they kneel when grubbing for food. The animal's appearance is generally unprepossessing.

African travellers met the wart-hog in great forests and in the bush, as well as in fields and reed beds bordering on forests. The animals like to stay near water. They rest in holes under the roots of trees, under boulders, or in natural crevices. As a result, a sleeping animal may be almost trodden upon and many a man has been surprised when this monster has appeared under his feet. While most hogs use their snouts for burrowing, the wart-hogs use their eye teeth. They kneel on the callouses of the forelegs and thrust themselves on to their feet by their hind legs. They are found from the Cape of Good Hope to Abyssinia and from North Somalia to French Equatorial Africa.

Babirussa

The **Babirussa** is no more attractive to look at than the wart-hog. It has one remarkable feature — the upper eye teeth in the male are extraordinarily long, thin and pointed. They turn upwards and in the case of older animals grow through the skin near the snout and bend backwards. The large lower canines grow upwards and also curve backwards so that the babirussa's face has an armament of enormous teeth.

This is a comparatively small hog, standing about $31^1/_2$ inches tall and measuring 3 feet in length. It has a thick folded skin, sparsely covered with bristles. The general colour is ash-grey. Females

have two milk teasts. The species is found only in the Celebes and adjacent islands.

PECCARIES
Family TAYASSUIDAE

The American hogs form a special family known as peccaries. Some of their features, such as the structure of their body skeleton, their extremities and their stomachs, show a kinship with the more highly developed ruminants. Professor Bouliere describes them as follows:

"Peccaries are wild boars of the New World. They are shy, diurnal animals which live in herds of up to one hundred animals. They are omnivorous and feed on fruit, roots, seeds, lizards and other small vertebrates. Their smelling glands, located on their backs, emit a musk smell when they are afraid which fouls the humid, calm air of the undergrowth."

The **Striped Peccary** reaches a maximum length of $37^1/_2$ inches and stands about $15^3/_4$ inches tall. Its whole body is covered with long, thick, black and brown bristles. The front of the chest is white. From the shoulders forward there is a yellow and white stripe which distinguishes this species from the white-lipped peccary. The striped peccary is found over the vast territory from Arkansas to Patagonia. It picks up its food from the surface of the ground.

The **White-lipped Peccary** is only a little larger than the foregoing species. On its throat it has a large white spot. The white-lipped peccary is found in forested areas of Central and South America, but in some places penetrates into the mountains where the limit of its range is 3,000 feet above sea level. It frequently covers long distances and can swim across great rivers. The female usually has one young at a birth. This species is frequently seen in zoological gardens.

Striped Peccary

HIPPOPOTAMUSES
Family HIPPOPOTAMIDAE

Hippopotamuses were once found in Europe and this is proved by the discovery of their bones in ancient deposits. According to the Bible they also lived in Palestine. Now they are confined to Africa where there are two species — the Amphibious Hippopotamus

and the Pygmy Hippopotamus. Hippopotamuses are large, stout animals with large, square heads. Their feet are four-toed with a swimming membrane between the toes.

The **Pygmy Hippopotamus** is less well known than the amphibious species from which it differs mainly in size. It is not a large animal and measures nearly 6 feet in length, including its tail of $6^1/_2$ inches. The maximum weight is about 880 pounds. The pygmy is not so dependent on water as the larger species and in its general habits resembles a pig more than a hippopotamus. Single animals or pairs are the rule, and herds are not formed.

The colour of the pygmy hippopotamus is brown or slate-grey with a pink flush on the cheeks, throat and abdomen. The species was discovered in West Africa in 1849 and attracted much attention from zoologists; but when no more was heard of it, doubts began to arise about its existence. Then, at the beginning of the twentieth century, it was proved that this hippopotamus was a real animal, inhabiting the wet forests of Liberia and the Sudan, and it was not long before specimens were brought to Europe.

The pygmy hippopotamus enters water only to swim. When hunted it does not seek refuge in the water; it retreats into the depths of the forest. According to Schomburg it sleeps in hollows in river banks. It feeds on fruit, cultivated plants and young shoots and can cause much damage in plantations.

Pygmy Hippopotamus

The **Amphibious Hippopotamus** is a much larger species and the better known of the two. It weighs from $2^1/_4$ to nearly 3 tons, reaches a length of 14 feet, including tail of $19^1/_2$ inches, and stands about 5 feet tall. The legs are short but extremely strong because they have to carry such a great weight. On boggy ground, the animal's abdomen almost touches the ground.

There are four toes on each foot. The outer toes are better developed than in any other even-toed ungulates. This species is well adapted to a life in the water, having swimming membranes between its toes, a well-rounded body, short ears, and nostrils which can be closed during submersion. The eyes and nostrils are almost on the top of the head, and the animal can submerge, leaving only these visible above the surface of the water. As a result, it can breathe and keep watch on its surroundings without showing any other part of its body.

The skin colour of this species is variable but most commonly grey. Other colours recorded are brown-and-red, grey-and-blue, reddish, near-white and spotted. The tusks, like the tusks of rodents, grow constantly; they are usually about $27^1/_2$ inches long and weigh 8 pounds. Malformed tusks reaching a length of six feet have been recorded. The upper eye teeth are weaker and grow downwards. There are forty teeth in all. The teeth of a hip-

popotamus and the inside of its mouth are familiar to almost everyone who visits a zoo. The animal's wide open mouth attracts a great deal of attention, besides various tit-bits, both suitable and unsuitable.

At one time this species was found over most of Africa, but its range has become more restricted in the present century and man has greatly reduced its numbers. It has disappeared from Egypt and from many parts of South Africa. Elsewhere it came close to extinction but was able to survive in vast inaccessible bogs where it was safe from white hunters. Nowadays, it is no longer threatened with extinction and can be seen on large reservations where it is a tourist attraction.

This is a gregarious species and herds usually number about fifteen animals, but much larger groups are not uncommon. The animals spend the day basking in the sun or lying in deep river pools. They come ashore at night to feed and use regular, well-trampled pathways to their grazing areas. Although they may not travel far from water, the animals cover considerable distances during the night, up to twenty miles. Where they are numerous, they can do great damage along river banks and to their own grazing areas. As a result of this the protection regulations have had to be revised. The emphasis is now on scientific management rather than on absolute protection.

Hippopotamuses are territorial and, like rhinoceroses, they drop their dung in regular places, scattering it during the act by wagging their tails.

During the breeding season the bull hippopotamuses fight fiercely; otherwise, the animals live a quiet life. The cows give birth to a single young after a gestation period of two hundred and forty days. The young is born in the water and is usually suckled there. Immediately after birth the young animals kick out instinctively with their legs, until they can stand with their heads above water level to breathe. It has been recorded that a young hippopotamus born on land, in a zoo, kicked out with its legs after birth as though treading water. The cows reach maturity in the second or third year of their life, but grow on for some time after giving birth to their first calf.

Where hippopotamuses are not disturbed, they will rest or sleep on small islands or sandbanks in the middle of the river. When in danger they submerge, rising at intervals of a few minutes to breathe, but they will remain underwater for periods of eight to ten minutes if the threat remains. Under such conditions, they can become dangerous and aggressive.

Dr. Baum has described some of his experiences with hippopotamuses:

"Young hippos at play are attractive animals. They press against each other in the shallow water, open their mouths wide and pretend to bite each other.

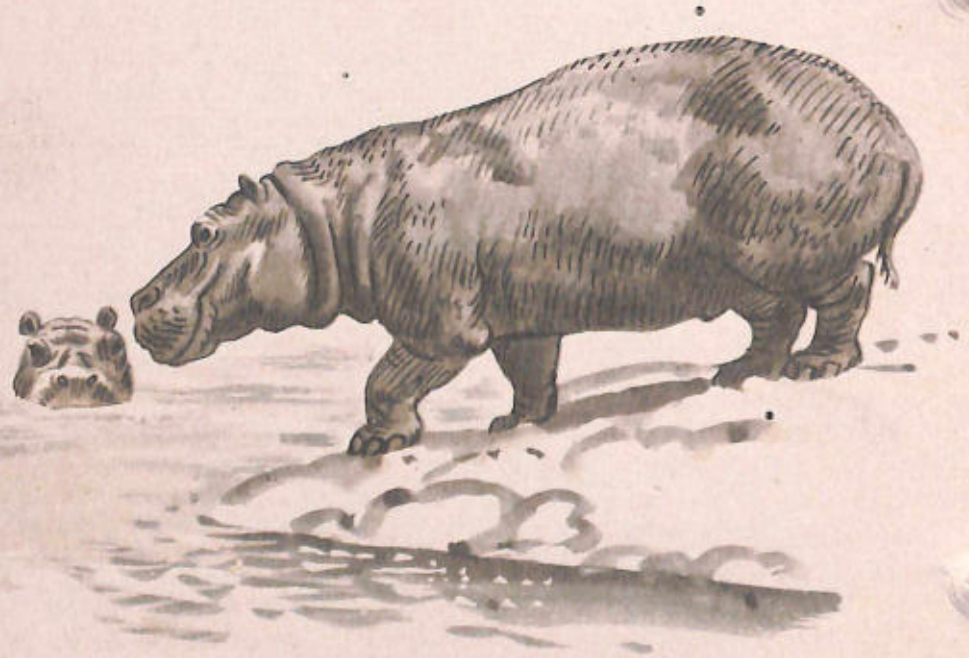
"When the hippos go ashore at night to graze, they sometimes find their way to cultivated fields where their presence is not welcomed by the Negroes. The animals I met were innocent, placid beasts that remained by the river, but this is not always the case. In regions where they are frequently hunted, they become irritable and prone to attack. Females with young are especially dangerous, as are wounded males. In such areas, the native boatmen carefully avoid places where hippopotamuses are lying. The famous hunter, Selous, had his boat overturned by a hippopotamus, although he was not molesting the animals at all.

Fortunately, the animal did not attack the people aboard, but it sometimes happens that an enraged hippopotamus will crush a swimming man with its teeth. Buckley mentions a case where the hippopotamus left the water and pursued a hunter who had fired a shot at it from the bank. About twenty years ago, a European hunter died near Fort Toureau when his boat was overturned by a hippopotamus, but such incidents and accidents occur most frequently when the animals are being hunted.

"My friend Monsieur Verebek, a Belgian, almost lost his life when hippo hunting with some friends in two boats. He wounded a hippopotamus, and the animal immediately attacked the boat, gripping it in its mouth and trying to crush it. Failing to do so, it heaved the boat high into the air so that the passengers were thrown out. Monsieur Verebek fell directly on the hippopotamus's back, but the animal fortunately was satisfied with wrecking the boat and paid no attention to the hunters. Two of the Negroes reached the bank, while the European and another Negro managed to get back into the boat."

That the hippopotamus knows how to defend itself is borne out from many books on Africa. Dr. Emil Holub in his book, *Seven years in South Africa,* wrote:

"A certain Masupia, sailing his boat on the river, came suddenly upon a hippopotamus asleep on a sandbank. Thinking it would be easy to kill the animal, he rowed towards it making as little noise as possible. He left the boat, stalked up to the sleeping animal and stabbed it behind the shoulder blade with his spear. The tip of the spear struck a rib and wounded the animal only slightly. Thus roused from sleep the hippopotamus at-



Amphibious Hippopotamus

tacked at once. The man flattened to the ground hoping that the animal would not see him, but he was not quick enough and when the hippopotamus rushed to trample him, he defended himself with his right hand. The hippopotamus crushed the hand with its powerful teeth, leaving it hanging by a piece of skin. Involuntarily, the man pushed out his other hand to save himself and the hippopotamus tore it clean away from the arm. Some fishermen, passing the spot later, found the mutilated man dying."

Dr. Baum tells how:

"One day, the inhabitants of the village heard stamping. Thinking that a white man was approaching on horseback, they ran out of their huts to welcome him. What they saw was a hippopotamus rampaging through the village in daylight. One of the old Negro women got in its way and was struck such a blow that several of her ribs were broken. Then the hippopotamus continued on its way to the river. Soon afterwards, one of the white men living nearby killed the angry animal."

CAMELS, LLAMAS, ETC.
Family CAMELIDAE

This group, the camels, has several special features. The stomach is divided into three parts. The limbs have developed more than in other even-toed ungulates, the side toes having completely disappeared. The weight of the body rests on the horny, elastic sole of the foot. The hind legs of camels seem unusually long, but this is because the thigh is connected to the body at its highest point so that the knee joint is very striking. In the case of other hoofed animals, the thigh is connected to the body much lower down at a fold of skin. A good example is the horse. The gait of camels is also different from that of most other mammals. The weight of the body rests alternately on the two right and the two left legs. In other words, the animal walks with the left hind leg following the left fore, and the right hind following the right fore. It is this unusual arrangement which gives the camel its unusual swinging motion. This gait is known as the amble or rack. Llamas and giraffes walk in the same way. Other animals follow the left fore foot with the right hind foot and the right fore foot with the left hind foot. The horse is a typical example of this.

The **Bactrian Camel** has two humps, one on the shoulder blades and the other on the hind-quarters. Its fur is richer and thicker than that of the Arabian, or one-humped camel; on some parts of the body, notably the neck and the humps, it becomes a mane. The neck is long, the ears short. The long, soft, drooping upper lip gives the animal a contemptuous and wise appearance. The lower lip is soft and moves up and down in rhythm with the animal's movements when running. Both species of camel have a skin gland behind the head which emits a sticky substance, especially in the mating season. The secretion of this gland has a powerful smell and probably helps the sexes to find each other over great distances. It has been suggested that these glands are a survival from the days when camels lived

in forests and rubbed the secretion on to tree trunks to mark their territories.

The Bactrian camel is generally bigger than the one-humped species, or Dromedary. The fur is dark-brown, more reddish in summer. During the moult the hair falls out quickly and in patches; consequently, the animals often have great tufts hanging from their bodies. At this time the Bactrians have a dishevelled appearance. The dromedaries, on the other hand, moult gradually over a period and never become patchy.

In both species, hearing is the most highly developed sense. Their sight is not outstanding. Their sense of smell is of little use to them in their search for dry, tough, vegetable food. They are shrewd at locating water and will search for it on their own initiative. Once they find it they are difficult to hold back and if they go into shallow water they soon make it muddy

Bactrian and Arabian camels have become adapted to different ways of life and this is really the main difference between them. The Bactrian is a tough animal, able to exist and work in low temperatures. It has calloused feet suitable for travelling over rocky terrain and a thick winter coat for warmth. It can thrive on the coarsest and driest vegetation and drink brackish, or salt water. It is not at all fond of juicy food. The Arabian camel, on the other hand, is an inhabitant of hot deserts and can survive for long periods without water. It can close its nostrils completely and has interlocking eyelashes to protect its eyes from the sun, two adaptations suited to its life in hot, sandy deserts.

There are few truly wild Bactrian camels alive to-day, but as domestic animals they are found over much of Europe and most of Asia. They are found in the Crimea, Asia Minor, and almost the whole of Central Asia, Mongolia and China. From Turkmenia eastwards, Bactrians are usually seen, but in Western regions both species are kept as domestic animals. The Bactrians can stand up to the severe climate of the mountains of Asia and are unaffected by frosts or icy winds, against which they are protected by their thick fur. In Central Asia, they can be seen living with yaks and in northern areas with reindeer. The species has long been domesticated and used as a beast of burden, besides providing hides, milk and flesh. Its dung has long been used as fuel. In Turkestan, the Bactrian as a domestic animal dates from the Bronze Age, but on Syrian monuments it is depicted as far back as 1100 B.C. Since the species did not exist as a wild animal either in Turkestan or Assyria, it has to be presumed that it was tamed farther east at an earlier date.

Wild Bactrians are still found in Asia, although they were once thought to be extinct. In 1957, a herd was discovered in Mongolia near the Altai mountains. The wild camel and the domestic one differ substantially in their appearance. The wavy mane, which is so typical of the domestic camel, is not found in the truly wild animals. The wild camel's ears are shorter. It has smaller humps, a shorter coat and smaller feet than the domestic form and is altogether a more slender animal. The colour of the wild camel is brown and red and is not so changeable as the domestic type. W. Leche, carrying out a field study, discovered many features in which the wild Bactrian differs from the domestic one. In the thirteenth century, Marco Polo drew attention to the fact that wild camels existed in the

heart of Asia, but Chinese historians had noted the fact long before Marco Polo's time. The first scientific report was given by Przewalsky, the discoverer of wild horses:

"Finally we saw the wild camels. We had our camp in a mountain pass, ten thousand feet above sea level. In the morning, we had 17 degrees of frost and there was an east wind blowing. Suddenly, one of the Cossacks noticed a wild camel about three hundred paces away. It obviously wanted to go down the pass, but after sighting our domestic camels it began to walk towards them. Suddenly it turned in perplexity and ran away. 'Wild camel', the Cossack shouted. The camel stopped about fifty paces from our camp and looked back at us, obviously puzzled by the domestic camels. Apparently it did not understand what it was all about."

In 1878, Przewalsky wrote about the existence of camels as follows:

"According to reports from the inhabitants of Lop Nor, wild camels live at present in the Kum-Tagu desert east of Lop Nor Lake. They are also to be seen in the sands of Tarim and in the Kuruk-Tagh mountains. More rarely, they can be seen in the Cherchen Darya River basin. Between Cherchen and Choton, they are no longer to be found."

Since Przewalsky's time, few zoologists have seen a wild camel. The range of these animals has been shrinking constantly and Bannikov reckons that wild camels are now to be found only in two areas: 1. largely near the southern frontier of Mongolia and 2. North-west of Lake Lop Nor in China. The surviving wild Bactrians are now protected by law, but like the wild horses their number is steadily decreasing. The development of cattle

Bactrian Camel

husbandry encroaches more and more on their pastures and watering places.

The territory of the wild camels lies between 5,000 and 6,500 feet above sea level. In summer, the camels live in scattered groups in the Gobi Desert. In winter, they move into the oases, or seek shelter from the severe winds on mountain sides. The groups usually number from five to fifteen animals; big herds or solitary males are seldom seen. Each group is led by an old male. In the breeding season, which is usually February, the males hold harems and fight for them. Quite frequently, a wild male will mate with a domestic female, and sometimes the mating takes place in reverse. Wild and tame stock have plenty of opportunity to meet on the vast grazing lands. It is said that the young of such crosses are much weaker than pure stock.

Although the two-humped camel is used as a beast of burden, it is in fact a rather delicate animal. It can stand up well to cold and snow storms, but is not so tolerant of high temperatures. Dom-

estic Bactrians require constant care and attention from their attendants. On long trips, the camel will carry a load of 440 pounds. Before loading the camel, the driver covers both humps with woollen, blankets to prevent chafing of the skin. Then, the saddle is fitted and to this the load is attached. In some countries, there are laws laying down the weight each camel is permitted to carry. This never exceeds 600 pounds. Although a loaded Bactrian camel walks very slowly, it can cover $18^1/_2$ miles in a day.

In zoos, camels can often be troublesome. When lying ruminating they are, without provocation, liable to spit the food in their mouth on to the visitors.

The **One-humped Camel,** also known as the **Dromedary,** measures up to $10^1/_2$ feet in length and stands $7^1/_2$ feet tall. It is completely unknown as a wild animal, but has been known in domestication in Arabia since about 1800 B.C. During this long period of domestication, several races have been developed. The Arabs recognise about twenty races having special physical characteristics. They breed strong, low-set types for carrying loads, and slim, long-legged types to be used as riding camels.

The fur of the dromedary is usually short and grey, or sandy coloured, and never forms a mane although it is longer on the nape, head, under the throat, and on the shoulders and neck. Like the Bactrian, the dromedary has hard callouses on its chest, elbows, heels and knees, and if it lies down the whole weight of the body rests on these. The animal is not in the least choosy about food and eats hard plants which other animals would not even notice. Because of this, the villagers have to protect the roofs of their huts with thorns to prevent the camels from eating the grass and reeds.

Dromedaries can live only on dry desert and wasteland and do not like humid regions with a rich variety of plant life. They are found mainly in the northern half of Africa, from Senegal to Libya and Abyssinia, but they are bred most abundantly in Arabia and eastwards towards Northern India. The breeding of dromedaries has been tried experimentally in other countries and to this day they can be seen in Spain, Italy and the Balkans. They were bred also in many parts of South Africa, but the place where they do best, outside their homeland, is Australia. The only part of the world where the two types meet is Western Asia and here they are frequently interbred. Interbreeding was carried out most successfully in Soviet Turkmenia. Cross-bred animals are, it is said, bigger and stronger than their parents. Crosses resemble dromedaries in general appearance and have one hump but their fur is like the Bactrian's. It is an interesting fact that these crosses are fertile.

In the deserts of Africa the camel is still an important beast of burden, in spite of the fact that the great camel caravans are less common than formerly. A dromedary, carrying a load of 330 pounds, travels at $2^1/_2$ miles per hour and in twelve hours will cover 31 miles. This may not seem a great distance, but it has to be remembered that the animals are travelling over hot areas of sand where there are no roads and where even the gravel and sand are hot from the fiery sun.

Sometimes caravans have to cross wide regions where there is no water and it is here that the camel's ability to survive for long periods without drinking be-

comes a great asset to man. Hardy races of Arabian riding camels can go without water for periods of five to twelve days. Here is what Müller has to say about this:

"The ability to endure thirst varies according to the type of camel, the region in which it lives and, above all, according to the season. If the air is dry the camels should be watered more frequently than when the air is humid. In Africa, camels can go without water for longer periods than they can in Asia. Camels in the mountains and humid regions of the Sudan and Somalia can go without water for a very long time. But this ability decreases eastwards and is least noticeable in camels on the high plains of Central Asia. Here, even in the months of March and April, the animals cannot remain without water for three days. Only in winter, when they can take snow, are they able to go without water for six days or longer. Nolde mentions the fact that in winter, even when they are working hard, Arabian riding camels can remain without water for twenty-five days, but they can go without water only for five days in the summer. The Bactrian camel is less able to do without water and in hot weather can go for no more than forty-eight hours. If deprived of water for three days it would die.

"In the West Sahara, the camels are watered only when the caravan arrives at a well. This means that they have sometimes to go for twelve days without drinking, but here their ability to do this depends on the time of the year. In winter, when the camel is resting and grazing, it can remain without water for up to twenty days. When working, however, it must drink every seventh or eighth day if it is not to lose too much weight. In summer, when the heat is greatest and the thermometer reaches 50°C., riding camels should not remain without water for three or four days, even when not

One-humped Camel

working. If the camel is travelling fast in the summer season it has to be watered at least every other day."

It is a well known fact that when camels set out on a trip after a period of rest their humps are full and erect, but that after a long trip, during which there was a lack of food and water, their humps are slack. Because of this it was once thought that the fat in their humps was a store on which the body could draw for nourishment. Then there was the explanation given of its ability to endure thirst. This was that the camel, before starting on its trip, drank a lot of water, which it stored in its stomach and drew upon a little at a time. And in many travel books we read that travellers suffering from thirst killed their camels and drank the water from their stomachs. Zoologists, trying to solve this mystery, interviewed experienced leaders of a number of caravans but learned nothing important. Eventually, it was shown that the old ideas were completely erroneous.

As in other animals, it was shown that water remains in the camel's stomach for only a short time and Krumbiegel has this to say:

"Not even the dromedaries, the real inhabitants of the African deserts, can remain without water for an unlimited period. They can go without water for a few days only, but food containing water can help to make up the deficiency. The animals can get along on very small quantities of water or on wet food, but they cannot live completely without water under any circumstances."

Nevertheless, it is a fact that camels can stand thirst far more easily than other mammals and the reason for this is not to be found in any special adaptation of the stomach at all. The solution of the mystery lies in the animal's humps. Albumens and fats burnt chemically in any organism will release water. From $3^1/_2$ ounces of albumen about $1^1/_2$ ounces of water are released and from $3^1/_2$ ounces of hydrocarbons, nearly 2 ounces of water. From $3^1/_2$ ounces of fat, over $3^1/_2$ ounces of water are produced. As the camel's hump contains about 66 pounds of fat, it can release about 70 pints of water. Therefore, the camel's thirsty organism receives water by a chemical process which renders drinking unnecessary for the time being. However, as soon as the camel reaches water, it drinks at great length. First to quench its thirst, and then to build up a store. To do this, it requires 70 to 80 pints of water. It drinks very seldom but when it does it takes in the maximum possible supply.

The voice of the camel sounds unpleasant to the human ear, but camel drivers soon become hardened to it. It is a mixture of grunts, moans, squeals and roars.

During the mating season, the males can be dangerous and their attendants have to be careful. The camels become irritable: they kick and roar and bite. At this time they are muzzled to prevent them from biting people. There are many cases of men being bitten, mutilated, or even killed by male camels during the rut. When a male camel sees another approaching he inflates the mucus membrane of the soft palate of his mouth. At the same time, he gurgles and roars. The older the male, the bigger the inflated sac produced from his mouth. Sometimes it becomes a balloon as big as a human head. It is emptied by inhalation and immediately falls back into its former position.

North America can be regarded as the

main centre of camel evolution, and the bones of prehistoric types can be studied in Pleistocene deposits there. Of course, all the descendants of these extinct species long ago ceased to exist in America. The only group of Tylopoda which has survived is the llama and it is found in the mountains of South America.

Llamas are much smaller than camels and differ from them mainly in having no humps. In other respects they resemble camels, especially in the shape of their heads. They have the same sort of feet, but do not walk on the soles. They walk on the edges of the hoofs. All llamas live on the plateaux of the Cordilleras. In equatorial regions they live at a height of 13,000 to 16,000 feet, but on the most southerly part of their range they live at much lower altitudes and are to be found even on the vast plains of Patagonia. They prefer regions with a cold climate. There are two wild species of llama and two domestic forms still in existence. In 1944, Krumbiegel described a third type of wild llama, but this has not yet been accepted by zoologists.

The **Guanaco** is the tallest animal in South America. It stands nearly 4 feet tall at the shoulder and nearly 6 feet to the top of its head. It is usually about 7 feet long and weighs from 130 to 165 pounds. Females are smaller than males. The general colour is dirty-red and brown, whitish on the abdomen and on the inner sides of the legs. The darkest zones, which are almost black, are the forehead, muzzle and the area round the eyes. On the hind legs there are elongated skin glands. Man cannot smell the secretions of these glands, but it is used by the guanacos for marking territory and for keeping the sexes in touch with each other. The fur is long, but not thick or soft, and protects the body against the cold mountain climate.

The guanaco is an inhabitant of the South American mountains, but it is found only in the Cordilleras and from Tierra del Fuego to Southern Peru. Fifty years ago it was found in many parts of Northern and Central Argentina, but it has been almost exterminated there by hunting. To-day it is nowhere numerous and its survivors fight a losing battle with extinction in the high mountains and glaciers where human beings seldom appear.

Guanacos are alert, clever animals and are largely dependent on the sharpness of their vision. While the herd is grazing the leading male stands a little apart, constantly searching his surroundings for signs of danger. The animals have good hearing, but their sense of smell is poorly developed. They are sure-footed and in rocky, treacherous, mountain country they move skilfully and at speed. Herds of ten animals are usual, larger groups uncommon. Present-day zoologists never

Guanaco

talk about herds of several hundred animals, but Charles Darwin, the famous English zoologist, saw a herd near the Santa Cruz river consisting of five hundred. This shows how things have changed. In South America, there is as yet little understanding of the need for protecting nature. The guanaco provides the hunters with meat as well as precious fur. Despite its wariness it is an easy victim, especially at lower altitudes, for men using hunting dogs and modern weapons.

Like camels, the male guanacos fight fiercely with each other during the mating season. The females give birth to one young after a gestation period of eleven months. The young are born clothed in fur and with their eyes open.

The guanaco is one of the mammals whose behaviour has given rise to the idea of animal cemetries. Adults which die of natural causes other than predation seek out a quiet place before death and Darwin described one such place near the Santa Cruz basin where many bones were to be seen:

"The river banks of Santa Cruz were white with bones which were lying on certain limited spaces hidden by bushes. I had thoroughly examined these bones. They were not scattered all around or bitten off by beasts of prey. The animals had got into these bushes before they died."

Pritchard, too, described such places, but we still do not know the explanation of this instinctive behaviour.

Domestic Llama

The **Domestic Llama** is a bigger animal than the wild guanaco and is often said to be its domesticated form. This is now disputed and in fact has been rejected because there are many behavioural differences between the llama and the guanaco which cannot be simply explained by domestication. It is now thought that there was indeed a wild llama and that it became extinct before the Spanish invasion of the Americas. The domestic llama was the beast of burden of the Ancient Incas and is still used in South America as a pack animal. The Indians of the high mountains of Peru keep large herds of them and make use of their fur, hides, flesh and fat.

In the domestic llama there is great variety of fur colour — brown, black and brown, reddish, mottled and even white. The fur is long and soft and as is done with other beasts of burden, the natives put a felt saddle under the load to prevent chafing. Although llamas are delicate compared with horses, camels or asses, they

are indispensable animals in Peru and Bolivia. They require gentle treatment and regular rest and food. They are docile and responsive but will kick and spit if irritated. They will not carry a load of more than 100 pounds, and cover at most 6 or 12 miles in a day. Only the males are used for work, the females being kept at pasture for breeding and the production of wool. The llama can travel with its load over terrain that would defeat any other beast of burden. It is never used as a riding animal.

When the Spanish conquerors first saw llamas they admired them greatly and described them in their first reports as "sheep". The descriptions were exact enough to enable us to say that there is no difference between the llamas of to-day and those the Spaniards saw many centuries ago. The animals were being used for transport in the mountains at the time of the Spanish Conquest and they still are.

At a much later date, scientists began their search for the ancestor of the domestic llama and it was Nehring who named the guanaco as such. This view, as we have said, has recently been rejected.

The **Vicuna** is another species of wild llama and the smallest of the South American camel-like animals. In colour it is yellow and brown but the abdomen and the inner sides of the leg are white. The vicuna has soft fur which is longest on the breast where it forms a tuft of white fur sometimes more than $7^{3}/_{4}$ inches long. This tuft flutters in the wind like a flag. The fur of this species is commercially valuable and that of the flag is the most valuable part. As the animals are small, they do not produce much wool.

At the time of the Ancient Incas only

Vicuna

royalty were permitted to wear robes made of vicuna wool.

The vicuna stands 30 inches tall and weighs a little over 100 pounds. In habits it is territorial and lives in small herds led by a single male. Young males are expelled from the herd by their mothers before they are one year old and live together in groups which sometimes number up to one hundred. Master males defend their territories against other males and attack by biting or spitting regurgitated food. The animals live near the snow line in the Andes, between 14,000 and 18,000 feet, and feed mainly on grasses and succulent herbs. They are much rarer than they used to be.

Since ancient times, the Indians have rounded up the vicunas, herding them into corrals where they sheared them like sheep and then released them. But the animals were hunted also for their meat. The Indians still round up vicunas for their wool, which is perhaps the lightest and finest produced by any animal. The vicuna has never been domesticated, and

being highly sensitive to climatic change is difficult to keep in zoos.

Not much is known about the vicuna in the wild state, but Tschredi has described how the animals are hunted by the Indians:

"The Indians rarely use a gun when hunting vicunas. When a hunt is organised every family on the plateau is expected to send at least one man to take part. Widows join the hunters to act as cooks. The hunters take with them sticks and many balls of rope. When a suitable area of level ground is found, the sticks are driven into the ground and connected by ropes to form a corral about 3 feet high. The corral is a large one — a quarter of a mile or more across. The women attach to the ropes pieces of coloured material which flutter in the wind. The men then spread out over a wide area and drive the vicunas into the corral, which is closed when they have all the animals they want inside. The pieces of coloured material fluttering on the ropes are sufficient to deter the shy vicunas from jumping out. The animals are now caught by way of the bolas, which is a long rope with three balls attached. The Indians swing the balls round their heads and throw them at the animals with extraordinary skill. The balls wind round the legs of the vicunas so that the animals cannot move. The furs, and any animals killed, become the property of the church. At the time of the ancient Incas, these hunts were carried out on a far greater scale than they are to-day and about thirty thousand Indians gathered every year to drive the animals from a circumference of twenty miles or more into the corral.

"I took part in a vicuna hunt at which one hundred and twenty-two animals were killed. The money received by the sale of the furs was sufficient to build a new altar in the church."

Vicunas keep to the grassy areas of the high mountain plateaux because their hoofs are soft and sensitive. They avoid rocky places. The animals are extraordinarily vigilant and the herds are difficult to approach. The animals are hunted not only for their wool but also for their tasty meat and this is why their numbers have decreased so much. One hundred years or so ago they were still to be found in some numbers far to the south of their present range.

They are still found in Peru, Bolivia, Argentina and Chile.

Alpaca

The **Alpaca** has been domesticated for more than two thousand years and no longer survives as a wild animal. As with so many domestic animals its origins are obscure. At one time it was considered

merely a long-haired domesticated vicuna, or guanaco, or the descendant of a cross between the llama and the vicuna. It is now thought to be the descendant of a distinct species that became extinct earlier than the wild llama. In modern times, alpacas have been crossed with llamas and with vicunas.

The Incas considered the alpaca a gift of the gods and devoted much care and attention to selective breeding. The most highly prized wool is white, but the usual colours are brown or black. At the present time, the alpaca provides most of the wool used by the Indians and it is reckoned that there are two million animals in Peru. The wool is light and warm and is proof against rain and snow. The herds live in the mountains up to the limit of vegetation at about 12,000 feet. The flocks are sheared every two years. Various attempts have been made to introduce the alpaca to many parts of the world — Europe, North America and even Australia — but all these attempts have failed. The alpaca is never used as a beast of burden.

RUMINANTS

The feet of Ruminants are exactly the same as those of non-ruminants, but their digestive system is quite different. They are well equipped for digesting tough vegetable matter. Their stomach is divided into several parts. In the case of camels and chevrotains, the stomach has three chambers, but in all other ruminants it has four.

Ruminants grasp the vegetable food in their soft, gripping lips and tear it off by pressing it between the incisors of the lower jaw and the horny pad of the upper. In the mouth the food is mixed with saliva and roughly chewed. It then passes down the gullet into the first part of the stomach, the rumen or first stomach; from there it passes in small pieces into the second chamber which is known as the reticulum. Here, the food is partially digested and, later, when the animal is at rest it is regurgitated in small quantities into the mouth where it is mixed with saliva and worked on by the powerful molars so that it is broken down still more. The pulped food now passes into the third stomach or omasum, and from there it passes finally into the fourth chamber, or abomasum. Here, the main digestion takes place. The process of regurgitation known as chewing the cud is repeated until all the food has been dealt with. This intricate system enables the ruminants to swallow vast quantities of food at one time and then digest it in safety later.

The teeth of the ruminants are specially adapted. In most species there are no upper incisors. Instead, there is a horny pad covering the bone directly above the six lower incisors. Many ruminants have antlers or horns on their heads, and the vertebrae of the neck are highly flexible. The main food of ruminants consists of grass, herbs, the twigs of bushes and trees, young plants, roots, fruit, water vegetation and even lichens. They mostly inhabit forests, boggy areas, tundras, wastelands, and mountains, but the greatest number of species as well as individuals is found on great plains in dry areas where they can use their running abilities to the greatest advantage. Females usually give birth to one young, exceptionally to two or three. The Chinese Deer is one such exception and may have six young at a birth.

The ruminants are useful to man as domestic animals and as game.

CHEVROTAINS
Family TRAGULIDAE

The stomach in this family is incompletely divided and resembles that of camels. There are no upper incisors. The molars are provided with a short crown and the upper eye teeth have developed into long tusks which protrude out of the mouth. The side toes are well developed. A gall bladder is present and the females have four milk glands. The animals under this heading, the Chevrotains, belong to a very ancient group which deviated from the main stream of development. Chevrotains are attractive animals and are dwarfs among the ruminants. Their general appearance is that of small deer and they are often referred to as mouse-deer. They are found mainly in South and South-east Asia and the Malayan Archipelago, but one species is found in the vast forests of Central Africa.

This is the **African Water Chevrotain,** which is dark-brown in colour with white spots on its back. There is a white stripe on its cheeks and flanks and a white patch on the throat. It is smaller than its Asiatic relative.

The best known species is the **Lesser Malayan Chevrotain,** or mouse-deer, which is one of the smallest living hoofed animals, standing only one foot tall at the shoulder and measuring about $21\frac{1}{2}$ inches in length. The fur is soft, reddish-yellow or brown on the back, darker and sometimes even black on top of the skull. On both sides there is a pale, narrow stripe running from the lower jaw to the shoulder blades. The belly fur is paler than the upper fur. The eye teeth of adult males are about $1\frac{1}{4}$ inches long and protrude below the lips as tusks.

African Water Chevrotain

The lesser Malayan Chevrotain is a forest animal, very timid in habits, which is found from plains up to a height of 2,000 feet. During the day, it lies up in dense cover and is extremely vigilant. It is solitary outside the mating season. It feeds on a variety of plants and bulbs and spends most of its life in the vicinity of water. If hunted until its strength fails it will lie motionless shamming death, but as soon as the enemy approaches it will rise again and try to escape by making long jumps. Because of its slim legs and body, it is not able to run for long distances. It relies mainly on its senses, especially its highly developed sense of smell.

Four species of chevrotain have been described, the other two being the **Spotted Indian Chevrotain** and the **Larger Malayan Chevrotain.** Although the species differ from each other in size and colouring it is difficult to identify them by colour alone as there is great variation within the species. Colour is, therefore, an unreliable guide. There is additional con-

fusion between the two species as older books on the subject use the name Javanicus for the larger Malayan chevrotain, which is now used for the lesser.

All the remaining even-toed ungulates fall into two groups, those with antlers and those with horns. Most of them have head attire, branched or unbranched, formed more or less of bone. They have from thirty-two to thirty-four teeth. The lower eye teeth resemble the incisors with which they are closely aligned. There are no incisors in the upper jaw. The animals in these groups have well developed ruminant stomachs divided into four parts. In these groups are deer, giraffes, antelopes, goats, sheep and domestic cattle.

Lesser Malayan Chevrotain

RED DEER, FALLOW DEER, ETC.

Family CERVIDAE

The outstanding feature of this group is their antlers. Only the males have antlers, except in the case of the reindeer where both sexes are antlered. In other species females with antlers are sometimes found, but these are exceptional cases. The only animals in this group which have no antlers at all are the Musk-deer of Asia.

Antlers are made of bone and are cast and regrown annually. They grow from special bony protuberances on the skull known as the pedicles. When the old antlers are cast, the surface of the pedicle appears like a raw sore, but the new antlers begin to grow almost at once. During the growing period the antlers are covered with soft, furry skin known as velvet, which is supplied with a rich network of nerves and blood vessels. The blood vessels nourish the growing bone. As bone growth proceeds, the growth of the velvet proceeds with it and by the time the antlers are fully grown they are completely covered in this velvet. A deer during this period is referred to as being "in velvet".

As soon as the antlers are fully grown the supply of blood ceases and the skin or velvet begins to die off. The deer rids himself of this skin by rubbing his antlers against branches or tree trunks or boulders, or by thrashing in tough vegetation. During the cleaning period, animals are frequently to be seen with tatters of velvet hanging from their antlers. The bone under the velvet is white but it darkens quickly as the velvet is rubbed off. Once the beast is clear of velvet he is said to be "clean" or in hard antler. Shedding of the velvet usually takes place shortly before the onset of the breeding season. During the mating period antlers are used when males are fighting with each other for females. In winter or in spring, depending on the species, the male casts his antlers and the whole process of regrowth begins all over again.

Some deer have simple antlers, the brockets of South America for example; others have well developed antlers, richly branched or provided with crowns or wide blades as in the case of fallow-deer. But all this growth of antler does not develop in the animal's

first year of life. The antlers begin as simple growths and develop year by year until the animal reaches his prime. The rate of growth is not the same in all animals, nor is there a definite addition to antler size each year. Growth rate varies according to breeding, feeding and environment, and the age of the animals cannot be accurately determined by reference to antler growth alone. In the case of red deer, the stags of Germany or the English parks grow a greater weight and complexity of antlers than those of the Scottish Highlands, but hill stags would produce as fine heads if they were transferred to such favourable environments. Once a stag has produced his maximum growth of antler he will repeat it for a few years with only slight variations. Then the process is reversed. Each year thereafter the antler growth becomes poorer and poorer and the stag is then said to be "going back".

Malformed antlers can be the result of damage during the growing period when the bone is soft, damage to the pedicles from which the antlers grow, or damage to the sexual organs. Abnormalities in antlers are frequently described and need not be dwelt upon here.

Although we know that antlers are used by males when fighting with rivals or with enemies, it is difficult to see what practical value they have. Their weight can be considerable and the males have to expend much energy each year replacing them. They are, therefore, a drain on the animal's bodily resources.

Most antlered animals are elegantly shaped and graceful in movement. They have slim legs and narrow hoofs, above which are two false claws. These do not touch the ground and leave their mark only where the going is very soft. There are scent glands in the cleft of the hoof; these leave negligible traces but can be distinguished by other animals of the same species. Other scent glands are situated on the outer sides of the hind-legs and are marked by tufts of hair. Below the eyes are other glands, located in the tear channels. On the forehead are other glands. Near the anus there are yet others which are important during the mating season, but not all species possess all these glands as we shall see.

It often happens that the young animals are spotted at birth and in some species these spots remain in adult animals. If we are to apply to deer the rule that the young of modern mammals, during development, pass through the individual stages of their ancestry (climbing their family tree as it were), we can presume that the forebears of the antlered animals were once all spotted as adults.

The musk-deer are regarded in zoological classification as a special sub family; the males do not grow antlers. They have eye teeth about 4 inches in length which protrude along the lower lip. A gall bladder is present in musk-deer but is absent in all other antlered mammals. They have no glands below the eyes and no heel glands. The stomach is divided into three parts. They are small animals with long, strong legs, the hind limbs being more powerful than the forelimbs. They have short, triangular tails. Their hoofs are broad and can be further broadened by special muscles so that the animals are well adapted for walking on difficult terrain such as snow fields, glaciers, or steep hillsides. The animals are skilful climbers and can reach places inaccessible to man. The males have in the skin of their abdomen a special gland known as the pod which secretes a strong musk smell.

The **Musk-deer** stands about 23 1/2 inches tall and measures 3 feet in overall length. Males weigh from 22 to 33 pounds, females from 15 to 26 pounds. The fur colour is variable and can be any shade of red and brown, or yellow and brown. The colour varies with the animal's surroundings. Seven geographical races have been described which differ in size and colouring.

These small deer live in the high mountains of Siberia, Mongolia, Manchuria, Korea and Tibet and from Western China to the Himalayas. Soviet zoologists record that they live mainly in mountain areas of mixed or coniferous forests, and boulder fields. They are found only rarely on bare, exposed ground and are not found in the lowlands at all. In the north, the musk-deer is found in the zone of stunted trees, but on the tundra it is hardly ever seen.

During the mating period, which is in December and January, the males chase the females and fight furiously with each other. Sometimes they inflict fatal wounds with the eye-teeth of their upper jaw. At this time the males smell very strongly of musk, which is secreted in the abdominal bag. The young musk-deer are born after a gestation period of five months. Twins are usual and they are born in lonely places among rocks, or in thick scrub. Younger females might produce only one young. The family remains with the mother until the next mating period.

The fur of the musk-deer is not valuable, but the animal is hunted for its musk. In Siberia, lajka dogs are used to hunt them, or traps are set on their runways to catch them. The musk is used as a fixative in perfumes. As a result of excessive hunting, the animal has been exterminated over much of its range.

When hunted, the musk-deer will sometimes seek refuge in a strong, leaning tree, and has been observed in branches 12 feet above the ground.

Musk-deer

In summer, the musk-deer feed on a variety of plants, flowers and grasses, but they will also eat the twigs of coniferous trees. In winter, they eat lichens and mosses which they scrape clear of snow.

One of the best known of all deer and certainly the best known in Britain is the **Red Deer.** The species is found over the Palearctic region as far as Manchuria and is found in the Oriental region along the southern slopes of the Himalayas. Seventeen sub species have been described, but it is extremely doubtful if many of these are genuine. Red deer vary greatly in size and appearance according to environment. Animals in the best habitats — for example forests — are naturally heavier than those in poorer habitats — for example on mountains; and there is a gradation in size from west to east, the larger animals being farthest east. So far

as Britain is concerned, the red deer has decreased in size since the Ice Age. The species has been introduced into Australia and New Zealand. Red deer are closely related to the wapiti of North America, which is a massive animal standing more than one foot taller than the red deer of Europe.

In Britain, the red deer is found mainly in the Scottish Highlands and Islands. There are considerable herds in the Scottish border counties. They are present in England on Exmoor, the Quantock Hills, the Lake District and the Brendon Hills; elsewhere small herds have become established. In Ireland, they are found in the counties of Kerry, Wicklow and Donegal. In Scotland, England and Ireland, herds of red deer are also kept in private enclosed parks from which escapes take place from time to time.

The red deer is the largest British species and Britain's largest land mammal. A mature stag will stand about 4 feet tall at the shoulder and a big specimen will reach a height of $4^1/_2$ feet. Antler growth in stags, and size and weight in either sex, vary greatly with feeding and environment. Hill stags from the Scottish Highlands will weigh from 210 to 250 pounds on the average, but animals of 280 to 320 pounds occur from time to time. Woodland stags and English park stags will weigh up to 420 pounds, while beasts from Eastern Europe and Germany are the heaviest of all and may reach weights of 490 to 560 pounds. This means that a moderate stag from the Scottish Highlands in good order may be little more than one-third of the weight of a stag from Eastern Europe, yet they are almost certainly of the same species. The same applies to antler growth; the heaviest and most complex antlers are grown by stags in the best habitats and it has been regularly shown that a calf from the Highlands of Scotland will reach park size if taken to England. Hinds are smaller and lighter than stags and stand about $3^1/_2$ feet tall at the withers. As a general rule, they are about half the weight of stags on the same ground.

Only the stags grow antlers. A few of them never grow antlers and are known as hummels in Scotland and knotts in England. It is general practice to name a stag by the number of tines on his antlers. Thus a stag with four points on each antler is an eight-pointer. If he has five on one and four on another, he is a nine-pointer; if he has five on each he is a ten-pointer and so on. The beast with brow, bay and tray tines and three points on top, forming a cup, is a Royal. In every forest there are stags with no tines above the brow point and these are known as switches. Very occasionally, a hind will develop horny rings or burrs on her head so that she might, at first glance, be mistaken for a hummel. A stag calf puts up simple spikes as a yearling and at this stage he is known as a knobber in Scotland and a pricket in England.

As in other species of deer the antlers are cast and regrown each year, the best and most forward stags casting first, usually in March, but many stags will be found with full heads in April and even May. Young animals can be seen still in hard antlers in mid-summer, or even later. The stags begin to clean the velvet in August or early September and are clean before the onset of the rut. Cast antlers are habitually eaten by Highland deer as a source of calcium.

Like body weight, antler weight varies according to feeding and general environment. The antlers of Scottish deer are

much lighter than those of England park deer. The average weight of British antlers is 15 pounds per pair, whereas the deer of the Carpathians frequently grow antlers weighing up to 28 pounds.

The usual colour of red deer is reddish-brown, but there is considerable variation from very dark to very pale brown. The rump patch is yellowish and this colour extends to the inside of the thighs. The hairy tail is about 6 inches long. At the onset of the rut the stags grow a prominent mane which gives them a thick-necked appearance. The calves are brown at birth, spotted with white. The winter coat is dark-brown, or greyish-brown and is dense, coarse and brittle. This coat is cast from May onwards, during which period the deer look ragged and patchy. Deer hair can be found at wallows where the animals roll in the wet peat.

Over most of its range the red deer is a forest animal, but in the Highlands of Scotland it has had to adapt itself to the almost treeless hills. Even in mid-winter most of the deer exist on almost bare ground, although in some parts they are given access to tall timber for wintering. In newly planted areas, or areas of young forest, they are fenced out, but the tendency nowadays is to give them access to forest cover in winter wherever possible.

The deer population of the Scottish Highlands is high in relation to the acreage available to them and this causes problems, especially in winter. Marauding deer break into farmlands, turnip fields or low ground grazings and in such cases can be legally destroyed by the owners at any time. The Red Deer Commission, a body whose operations are confined to Scotland, is responsible for controlling marauding deer. Red deer in Scotland and England now have a statutory close season. In Scotland this is from 21st October to 30th June for stags and 16th February to 20th October for hinds. In England, the period is 1st May to 31st July for stags and 1st March to 31st October for hinds.

In Scotland, shooting with rifles of proper calibre is the approved and standard method of deer control and each forest is obliged to kill a specified number of stags and hinds each year. Generally speaking, red deer are usually undershot in Scotland as a whole. Stag shooting is generally let to tenants who are concerned mainly with trophy heads, whereas hind shooting in the main is left to the professional stalkers. In all the big forests the tenant is accompanied by a professional stalker. In England, besides being shot with the rifle, red deer are hunted in the south-west by the Devon and Somerset Stag Hounds. An agent of the

Growth of antlers of Red Deer Stag of 2, 4, 6, 8 and 10 years

hunt, known as the harbourer, selects the stag to be hunted. He finds out where the stag is lying on the night before the hunt and in the morning the animal is roused from its lair by a few selected hounds known as tufters. Once the stag is on foot the rest of the pack is laid on. When the stag is brought to bay, usually in water, the huntsman is supposed to shoot him there. Hinds are also hunted in this way. The Devon and Somerset are the only pack of stag hounds hunting in Britain, and their activities arouse annual opposition in England. It has to be understood that a number of deer must be shot in Britain every year in the interests of the animals themselves as well as in the interests of forestry and farming. There are no natural predators in the British Isles and man has to do the work of control for himself. The need for control is recognised by everybody and there is no opposition to the methods employed in Scotland, which compare with any in the world. The Devon and Somerset Hunt attracts all the criticism.

In Scotland, outside the deer forests, the killing of deer is less under control and unsuitable weapons are often used.

In recent years, the Nature Conservancy has been doing excellent work on red deer research on the island of Rum. This work is continuing and should provide much valuable information on deer management and control. Research is also being carried out on the mainland, and there are several tagging schemes in operation.

The breeding season of the red deer is known as the rut. Before the onset of the rut, stags and hinds live more or less in separate companies, but as each stag comes into breeding condition he leaves his fellows and goes out in search of hinds. When he breaks into the hind grounds, he announces his arrival by loud roaring. He rips the heather with his antlers and wallows in peat hags; then he gathers as many hinds as he can and tries to hold them against other stags coming fresh to the rut. The peak of the rut in most years is in October, but it begins in September and may drag on into November. The master stag, that is a stag in charge of hinds, is kept on the move night and day in his attempts to hold them. Once he is exhausted he retires and is then said to be "run out". The hind group is then parcelled out amongst lesser stags and still lesser animals until the rut dies away. Hornless stags, or hummels, are sometimes master stags, but there is still some doubt as to whether they breed hummels.

The gestation period is eight months and most calves are born in early June. The peak period is the early part of June and single calves are the rule. The calves are spotted at birth, but the spots disappear with the growth of the winter coat. The hind suckles her calf right into the winter and it remains with her until its second autumn. Mortality amongs hill calves is high and late-born calves stand a poor chance of surviving. In severe winters many deer die, mainly because there are too many of them for the amount of winter grazing available. Once out of the calf stage, the young red deer has no enemies apart from man. Still-born calves are eaten by foxes and eagles. Foxes, eagles and wildcats prey upon very small calves, but the extent of such predation is not known.

As we have already said, seventeen subspecies of the red deer have been described, but it is doubtful if many of these can be justified. The **Central European Red**

Deer is regarded by Central Europeans as the most beautiful race, both in bodily structure and in the widely branched antlers which end in symmetrical crowns. The Central European red deer has a short face and is a smaller animal than the eastern type. Young males, after their teeth are mature, weigh about 220 pounds gralloched (that is disembowelled). At their maximum they reach a weight of 330 to 350 pounds. Their antlers grow slowly and in their third year they do not have more than four tines, rarely five. The winter coat of both sexes is rust-brown, while the summer coat is brilliant red and brown. In Slovakia, the **Carpathian Red Deer** now occupies the ground formerly held by the Central European type.

The outstanding feature of the Carpathian race is its body size. In the third year of its life, the Carpathian stag reaches a weight of 330 pounds gralloched. Old males weigh from 440 to 550 pounds gralloched. This type is long-faced and its antlers grow quickly in size and number of tines. Animals of two or three years of age can have from six to eight tines on each antler. The antlers of the Carpathian red deer sometimes form a crown, but underneath it the fourth tine usually divides into a fork. The winter coat has no red in it so we sometimes call the Carpathian race the grey deer.

It is interesting that this race can grow such powerful antlers in such a short time. Casting takes place in February and March and the new antlers are hard and clean at the end of July or the beginning of August. Old stags are clean earlier than young ones. The antlers of Carpathian deer weigh up to 30 pounds, and are, like the antlers of red deer anywhere, greatly influenced by food supply. Antlers are mainly composed of calcium carbonate and calcium phosphate, and their size can be directly influenced by adding mineral substances to rich foods containing albumens, and fats. Experiments along these lines have been carried out by Vogt.

At the present time the Carpathian red deer live mainly in continuous forest, especially mountain forest, and in summer they can be seen on mountain tops high above the tree line. Before the lowlands became so densely populated, the deer were also found there. It can be assumed that, originally, the deer lived in low, open forests and were driven to the high forests by human pressure.

The red deer is an excellent runner and when pursued can attain a speed of 37 miles per hour on level ground. When hard-pressed, it will make great leaps of 36 feet. It is not afraid of water and can swim wide rivers with ease. As a general rule, the red deer is a silent animal. For most of the year the sound most likely to be heard is the hoarse bark of a hind. With the onset of the rut the stags become vocal. The roaring of the red stag is not always the same sound and experienced hunters can distinguish old stags from young ones by the strength of the voice. They can also tell the mood of the animal. The roaring of a stag in search of a hind is quite different from the roar of a stag in possession of hinds. The roaring of an animal announcing his overlordship is different again. European hunters sometimes "call" the stag within shooting distance by imitating the appropriate roar. He does this by means of a whistle cut from a shell of the sea mollusc, triton, or from a cow's horn. The stag is not easily deceived and the hunter has to know exactly what he is doing to be successful. Unlike the red stag, the Siberian maral

and the American wapiti emit only soft, whistling sounds.

Professor Komarek has described the rutting of Carpathian red deer and his description would fit equally well the rut in Scotland or any other part of Europe. He writes:

"We go over the forested peak at dawn and come to a halt on the edge of a glade from which we can hear the roaring of red deer in the distance. It is a proud roar expressing mastery, and ends in a challenge to all rivals. Presently, we can hear the roaring at close hand. By its tone and its jealous challenging, we know that this is the roar of a stag in possession of hinds. In the meantime, the sun has appeared over the horizon. The stag is now walking round his hinds and looking from time to time into a nearby thicket. He stops, and with his antlers laid along his back he bellows until the vapours can be seen coming out of his open mouth. He is challenging his young rivals who are waiting in the vicinity trying to cut out some of his hinds. He is uttering at the same time peculiar, short grunts which end in a bellow to frighten away his rivals. The stag emits the same sound when chasing a hind. Very old stags, especially those of the Carpathian forests, bellow very little in the period of mating, but they do bellow quite certainly in the morning when they seek a hiding place in the thickets, or when they come to the brooks to bathe. Their voice in this case sounds like a deep muttering."

Sambar

Very infrequently, a master stag will kill a rival during a fight. More frequently, but uncommonly, the antlers of two stags become interlocked and they die of starvation sometime later.

The **Maral** is the Siberian relative of the North American wapiti. It is found in Tian-Shan and the adjacent mountains, in Ala-Tan, in Altai in the Sian mountains and in the region of the Baikal Lake.

The **Wapiti** is found in North America. According to a map by W. Hurt, it is found to-day in the mountains of western North America and in a narrow coastal strip of the Pacific Ocean. It is found in some of the big North American reservations and farther north in three separate areas of the Great Lakes.

The wapiti derives its name from the Shawnee Indian. It is a mountain species and gregarious at all times. The mass migration of wapiti is well-known and takes place when the local food supply fails. In such years they gather in big herds and move to regions where the snow is not so deep and where they can obtain food. Herds of up to one thousand animals have been observed migrating from mountain areas to lower ground.

The **Sambar** is represented by many races in India, Burma, Siam, Sumatra, Borneo, Taiwan, West China and the Philippines. The colour is mainly black

to blackish-brown and the species has a mane. It has long, strong, rough antlers with three tines. The Indian race stands over 5 feet tall at the shoulder and has antlers up to 4 feet long, while the small Philippine race stands no higher than 28 inches at the shoulder. It is an important game animal.

Schomburg's Deer is found in Siam and is a relative of the Swamp deer. It stands just under $3^1/_2$ feet at the shoulder and has much-forked antlers measuring up to 33 inches in length. The colour is brown above and white below.

The **Swamp Deer** is found in India, north of the River Ganges. It stands up to nearly 4 feet tall at the shoulder. There are from four to eight points in each antler. The summer colour is reddish-brown above and white below. The winter coat is yellowish-brown. There is a row of white spots on each side of the dark spinal stripe.

Eld's Deer is a shy species found in the river valleys east of the Bay of Bengal, from Manipur to the Malayan Peninsula. It frequents open areas of marshy ground with scattered forest and avoids thick jungles. It has lyre-shaped antlers which are forked only at the tips.

The **Sika Deer** is found in Manchuria and East China, in Japan, Korea and the Ussuriysk. The summer coat is chestnut-brown in colour with big white spots arranged in rows. The winter coat is much darker and is unspotted. In Japan, the sika deer lives in a semi-wild state in parks. In the U.S.S.R. it has almost been exterminated as a wild animal but is still kept in large numbers in reservations.

Schomburg's Deer

Swamp Deer

Eld's Deer

Sika Deer

Its antlers are used in the production of a medicine which is extracted from dried antlers in the velvet. The antlers are cut off when the animals are about three years old. Three-year-old bucks have antlers weighing from 7 ounces to $1^1/_2$ pounds. Eight-year-old animals have antlers weighing up to $3^1/_4$ pounds.

Several races of sika deer have been kept in deer parks in Britain, but the one that has become established in the wild state is the Japanese. This is the type found in many parts of Britain.

The sika closely resembles the red deer but has a skulking gait. The stag stands a little over 3 feet at the shoulder. The hind is about the height of a fallow doe. The stag's antlers are more slender than the red deer's and carry six to eight points. In the velvet, the antlers are red with black tips. The calves are spotted at birth. The sika's white rump patch is edged with black and when spread is heart-shaped.

On the hill the sika eats the same food as the red deer and can exist on the toughest herbage. They are fond of hazel shoots and bark. Sometimes they raid arable crops and can cause damage to potato pits in winter. They like lying up in deep bracken or heather, in thick or dense stands of young conifers. They also frequent birch and alder swamps. In general, they are deer of mixed and deciduous forest, especially the forest fringes and of alder and hazel thickets with plenty of ground cover.

Sika stags are polygamous during the rut and gather a harem of six hinds or less. The rut is in late September, through October into November. A single calf is born at the end of May.

The voice of the sika stag is distinctive and can be mistaken for that of no other British deer. He whistles and grunts two or three times, and then remains silent for periods of fifteen minutes up to one hour. The rut of the sika deer is quieter than that of the red. Rival stags engage antlers and push, sometimes displaying real truculence, but there is little of the commotion and noise which is a characteristic of the red deer at this time. After the rut two or three stags may run together, and small groups are always more likely to be seen than big ones. Stag companies will run together until the spring and until after they have cast their antlers. Small groups of either sex are the rule, but it is not uncommon to see the sexes together outside the rutting season.

Sika deer usually lie up by day and are not often seen on foot until dusk when they come out to feed.

The **Axis Deer,** or **Chital,** of India and Ceylon resembles the sika. It is about 5 feet in length and stands up to over 3 feet tall at the shoulder. It is red and brown in colour, irregularly spotted with

white throughout the year. The antlers produce a maximum of three points on each side. The intertoe glands are found only on the hind feet.

The chital occupies the same areas as the sambar. It is a diurnal species, whereas the sambar is nocturnal. The chital is a common species of European Game Parks.

Père David's Deer, named after its discoverer, is extinct as a wild animal. It was discovered in 1865 by the Jesuit missionary and zoologist, Père David, in the Chinese emperor's hunting park south of Peking. At that time it was already extinct as a wild species. Formerly it was found in North China, Manchuria and even in Japan. Soon after Père David's discovery, specimens of this deer were sent to Europe and a herd was built up by the Duke of Bedford at Woburn Abbey. This was fortunate because the species became totally extinct in China in 1900 during the Boxer Rising. During the shelling of the European forces, the walls of the Royal Hunting Park were damaged and the deer escaped to be killed off by the local population. At the present time there are more than three hundred Père David's deer alive, some in zoological gardens, but the main herd is still at Woburn Abbey in Bedfordshire.

Père David's deer is a strong animal about the same size as the red deer, but it has a much longer tail and completely distinctive antlers. The antlers are peculiar in having a long, slender hind prong and a forked front prong. Père David's is the only deer which sometimes grows two sets of antlers in the year. The summer antlers are cast in November and the second set, if grown, are clean and hard in January. They are dropped a few weeks later.

The large hoofs of this species suggest that it was an inhabitant of marshy ground. Captive animals swim well and readily, and during the summer feed mainly on water plants. The mating season is in June and July.

Axis Deer

Père David's Deer

Fallow Deer are red and brown in colour and have more of less spotted coats, the spots being arranged in rows. The under parts and the rump patch are white. In winter the coat is darker and the spots indistinct, or absent. Fallow deer have characteristic antlers which are palmated like those of the moose. Fallow deer have no tusks on the upper jaw.

The fallow deer is found in Europe up to about 60°N. latitude and in Asia Minor. There is still much argument as to whether or not it is a native of Britain or an introduced species. At the time of the Norman Conquest it was already well established because it is recorded in the Domesday Book. Wild herds still exist in Scotland as well as in Ireland, but the species is most common wild or in parks in England where descendants of the original herd are still found in Epping Forest, the New Forest, Rockingham Forest and Cannock Chase. Escaped animals have formed small groups in most wooded areas of England. In Scotland, wild fallow exist in the Borders, Perthshire, Argyll and Ross.

In Britain, mature fallow bucks stand about 3 feet tall at the shoulder but weight varies a great deal according to food supply and the density of animals on the ground. A good average weight is 140 pounds gralloched, but up to 240 pounds has been recorded. Winter-fed fallow have reached a weight of 280 pounds. Does are smaller and lighter than bucks.

There are two main colour phases, the brown or fawn type, and the dark type. In the first type the coat is spotted with white in summer and is grey-brown and unspotted in winter. The second type has hardly any visible spotting. Fawns are spotted at birth. The spotting is indistinct in the dark types and white in the light types. The tail is black on the upper side and white on the under side. Black fallow and white fallow are also quite common in Britain.

The antlers of a fallow buck are palmate with the hind edge notched like an oak leaf. The palmation broadens with maturity and the antlers are at their best when the animal is between seven and nine years old. They are cast in April or May and the new ones are cleaned in late August or September. The biggest antlers take the longest time to reach full development.

During the rut, which is in October and lasts for about four weeks, the bucks snort and groan, but there is very little fighting. The fawns are born in late May or early June of the following year after a gestation period of thirty-two weeks. Out-of-season fawns are not uncommon. Most does produce a single fawn but twins occur from time to time. The does suckle their fawns right through to the following spring.

The main food of the fallow deer is grass, but a wide variety of vegetation is eaten. The fallow likes acorns, horse-chestnuts and beech mast. It browses the twigs of hardwood trees and bushes and sometimes causes damage by barking. Brambles and other wild fruits are eaten.

The evidence that the fallow deer is indigenous to Britain is slender and it was very probably brought by the Romans who introduced it to so many parts of Europe. The species has always been a favourite in deer parks where it thrives and is a great attraction. As a park animal it has a further advantage; tame fallow bucks, unlike tame stags or roe bucks, are not dangerous during the rut.

Feral herds of fallow deer can sometimes do serious damage to forestry and

XI 1. *Fallow Doe — albino* 2. *Fallow Deer* 3. *Moose* 4. *Red Deer* 5. *Wapiti* 6. *Reindeer* 7. *Roe Deer*

agriculture so that control by shooting is necessary. Control is much more humane than it used to be and the Forestry Commission has played an important part in improving deer management. Once out of the fawn stage, the fallow has no enemies apart from man. The fox is the main wild predator on fawns.

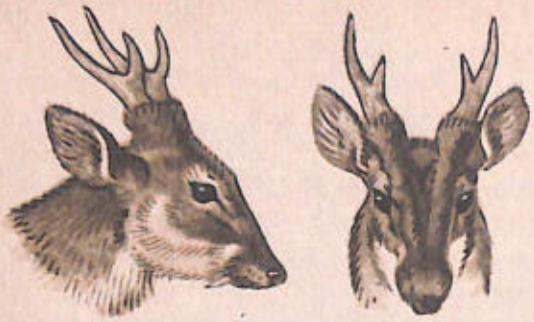
The Romans, as we have said, introduced the fallow deer to many parts of their European empire. The original wild stock inhabited the Mediterranean area and Asia Minor where small numbers still exist to-day. The Romans kept fallow deer in Game Reserves in ancient Gaul, the France of to-day, and the animals have been kept in parks in many parts of Europe since the Middle Ages. As in Britain, many fallow escaped from European parks to form feral herds with resulting damage to agriculture. Fallow deer are now kept in reserves in Western, Central and Southern Europe, in the Western Ukraine, the Baltic republics of the Soviet Union and even in North Africa.

The **Persian Fallow Deer** is found in the Luristan Mountains of Persia. It is a bigger animal than the fallow, more brightly coloured and its antlers are incompletely palmate. Bucks of this species weigh up to over 400 pounds.

The species was thought to be extinct and was then rediscovered. The first specimen to reach Western Europe was killed in 1875 by the British vice-consul at Basra, Mr. Patrick J. C. Robertson. It was killed on the frontier of the Luristan and Arabistan provinces. The skin and the skull, complete with antlers, were sent to the secretary of the English Zoological Society, Mr. Sclater, who gave them to the British Museum. The specimen was fully described by the great deer expert of the time, Sir Victor Brook, who classified it as a fallow under the name *Cervus dama mesopotamica*. Further specimens reached the British Museum in the next few years. A pair of antlers of this fallow were sent to the London Zoological Society in 1877/8, but these unfortunately disappeared. The discovery of this fallow deer roused the interest of Hagenbeck who sent an expedition to Luristan in 1890. The expedition came back with only one trophy which was kept in Hagenbeck's villa, but it was stolen from there at the end of the First World War and was never recovered.

Other antlers were secured in 1917 and by the end of the First World War the species was thought to be extinct. Then, in the year 1956, W. Trense of Munich heard during his stay in Persia that deer fitting the description of the Persian fallow still existed in the south of that country. On his return home Trense, supported by G. von Oppel, organised an expedition which discovered that the deer were real Persian fallow. One adult animal was killed and the young one captured was brought to Germany alive. Many antlers were also brought to Germany and the existence of the Persian fallow was completely confirmed.

Persian fallow live mostly in gallery forests in the area of the Karun River in a zone between under half a mile to $1^1/_4$ miles wide. This is an area of poplars, willows and mimosas and in some places the growth is so thick that even the buffaloes have to crawl along their paths. The country opens out into glades covered by mimosas, then becomes steppe. Here the fallow deer are to be seen and beyond this on the forest-covered hillsides they spend the hot summer season.



Indian Muntjac

Muntjac are primitive deer found in South and East Asia. They have short, simple antlers and long pedicles. The antlers have either no tine or a simple brow tine. In the upper jaw, muntjacs have long, strong eye teeth which protrude from the mouth.

The best known species is the **Indian Muntjac,** or **Barking Deer,** of which there are several races. The species is found in India, Burma, Malaya, Sumatra, Borneo and Java. It is about 4 feet in length and stands between $19\frac{1}{2}$ and $21\frac{1}{2}$ inches tall. Superficially it resembles a small roe deer. The general colour is yellow and brown and the hair is short, thick and tight. The antlers are whitish, or yellowish, in colour.

This is a forest species but prefers mountain areas. In the Himalayas it ranges to a height of nearly 10,000 feet.

The bark of the muntjac is harsh and noisy and is uttered during the mating period or when the animal is frightened.

Indian and **Chinese Muntjacs** have been introduced to England and are now feral in a number of places there, but the species most likely to be seen is the Chinese. The Indian species was introduced to Woburn in 1890 and the Chinese in 1900. The two types have interbred. The most widespread is the Chinese. Muntjac are now established in Bedfordshire, Buckinghamshire, Hertfordshire, Northamptonshire and Warwickshire and are reported from time to time from other parts of England.

Muntjac are generally reddish or yellowish-brown in summer and darker in winter. The rump patch, chin and throat are white and there is an obvious tail. The fawns are brown with white spots. Adult bucks weigh up to 50 pounds and does up to 30 pounds. The antlers of the bucks are about four inches long and have a single brow tine.

Very little is known about the breeding of the muntjac, but fawns are born in late summer. Singles are usual but twins have been recorded. The bucks and does run together from about October until the spring.

Because of its small size, the muntjac is a difficult animal to see even in sparse cover, and so is often missed. It feeds early or late in the day when it may be seen in open spaces or on the outskirts of woodland. Small groups can sometimes be seen in winter, but the animals are usually seen singly or in pairs. In some areas, they can do considerable damage to field crops. They eat grass and browse twigs but also eat fruits and root crops.

The next group includes the well-known roe deer. Roe are beautiful, slim, medium-sized deer which are widely distributed in Europe and occupy a great variety of habitats. They are found as far north as the 62nd parallel in Sweden and as far south as Sicily, and from the British Isles to the Far East, but they are not found in North Africa, Japan or North-west India. In the British Isles, the roe is widely distributed on the mainland

of Scotland. It is absent from Wales and Ireland, but spreading in England. It is found on the islands of Islay, Seil and Bute.

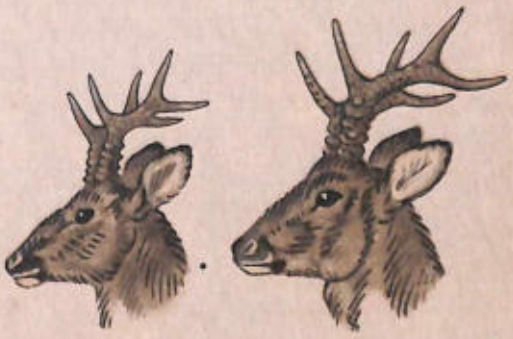
Roe Deer are forest animals but this description has to be qualified as they thrive in a variety of habitats from mature forest to the open hill. Some animals can exist on the thinnest of cover throughout the year and a few seem to spend their whole lives on open mountainsides. They like woodland, spinneys, young plantations, areas of scrub, or birch and alder thickets. Where forests have been clear-felled, they will move into the second growth. They like shade in summer and some sort of cover in winter. They are strongly territorial and when settled will spend their entire life in the same area.

The antlers of the roe buck are upright, three-pronged and about nine inches long. Many bucks have antlers smaller than this and some grow antlers of ten inches or longer. Infrequently, a roe doe will grow antlers which remain permanently in velvet and are never cast. The adult buck sheds his antlers in November or December and cleans his new ones in March or early April. The strongest and heaviest animals grow their antlers more quickly than poorer beasts and clean them earlier. The yearling buck may grow simple spikes or he may show a fork, or he may even produce a reasonably good six-point head. This is influenced by feeding and breeding. It is not true as was once stated that the buck grows spikes in his first year, four points in his second year and six in his third. There is much variation in rate of growth and antler size depending on habitat.

The buck fawn grows his pedicles in autumn and towards the end of the year a hard, horny growth pierces the tips. These are so-called "buttons" and are not antler material. In January, or February, depending on the rate of growth and other factors, the buttons break off, leaving raw sores. Now the proper antlers begin to grow and these are covered in velvet. Unlike the buttons they have proper coronets, that is a pearled ring of bone at their base.

The adult roe buck will stand from 21 inches to 25 inches at the shoulder and weigh between 50 and 70 pounds. Does are smaller and lighter and a very good one will scale 45 pounds.

The summer coat of the roe deer is foxy-red. They have grizzled faces and dark muzzles. The chin is white and there are two white spots on the upper lip. The nose and the sides of the muzzle are black. The winter coat, which grows in during October and November, is thick and brittle and varies through many shades of greyish-brown to dark-brown. Many roe have a white patch on the throat and another on the gullet when they are in winter coat and this is characteristic of Scottish roe of all ages and either sex. The rump patch in both sexes is buff or creamy-buff in summer and



Comparison of size of heads and antlers: Roe Deer and Siberian Roe Deer

white in winter. There is no visible tail but in winter adult does grow an anal tuft which looks like one. Fawns are reddish-brown, heavily spotted with white at birth. The spots disappear in the early autumn.

The rut of the roe deer is in July or August and at this time the bucks pursue the does in circles or figures of eight. These rings, which are often referred to as the fairy rings of the roe deer, become clearly marked with much trampling and are used daily during the mating period. The same rings in the same areas may be used for many years and then deserted.

Bucks are territorial and mark off their territory by rubbing their scent glands on trees, fences and bushes round its perimeter. A master buck on his territory will tolerate no other inside it and will immediately fight any intruder. Such fights can be very fierce, but usually the weaker beast breaks off as soon as he realises he is being mastered. Once he retreats he is not usually followed by the victor, although occasionally, an old buck will drive the defeated one clear off his territory. Such fights do not usually result in much damage, but, once in a while, one buck may injure another seriously, and on rare occasions one may kill another. There is a Scottish record of a buck dropping dead with the top tine from his opponent's antler embedded in his skull.

In roe deer, twin fawns are the general rule and triplets occur quite regularly. Mortality can be high so that triplets are seldom reared and many does succeed in rearing only a single fawn. In some areas where fawns are regularly dropped in hay fields, the fawns are cut to pieces by the reaper. Others are killed by roving dogs, and foxes are predators on very young fawns.

During the first few days of their lives the fawns remain hidden and are visited by the doe only to be nursed, but once they are strong on their legs they run with her.

Roe fawns are born in the last week of May or early in June, but out-of-season fawns have been recorded in April, July and August. In this species, there is delayed implantation. The fertilised ova reach the blastocyst stage and then lie dormant until the end of December when implantation takes place and proper development of the young roe begins.

Roe deer eat a wide variety of food apart from grass. This includes the leaves, buds and twigs of many hardwood trees and bushes, hazel, alder, elder, oak, ash, chestnut, beech, birch and thorn. They also eat a wide variety of fruits as well as the twigs and leaves of fruit-bearing trees. They will eat holly, yew, broom and pine, and in a young plantation they can cause damage by browsing on young conifers.

In England, roe deer does have a statutory close season, but there is no close season for bucks. In Scotland, there is a statutory close season for both sexes. The Forestry Commission had close seasons for both sexes in all state forests, long before this. This deer is mainly a forester's problem, when it is a problem. The deer damage young trees by browsing and fraying. Browsing becomes serious if the deer nip out the young shoots of conifers, thus deforming the tree. Damage by fraying is done when the bucks are cleaning the velvet from their antlers. They rub against the soft bark and if this is rubbed off right round the tree it dies. Young conifers and poplars are favourite fraying stocks.

Roe deer feed mainly at dusk and dawn

and on and off during the night. They spend the day lying up in cover, resting and chewing the cud, but where they are not being disturbed they can be seen on foot at other times of the day. Roe deer living on the open hill will feed throughout the day like the red deer. They become crafty with age and can hide in the scantest cover. When hard-pressed, they will crawl on their bellies under bushes or fence wires to avoid discovery and can often be seen emerging from a wood after a line of men have passed through it during a drive for foxes.

The striking rump patch of the roe deer, variously referred to as its mirror, disk or flag, spreads and contracts according to the deer's degree of nervousness. When the animal is thoroughly alarmed the white area reaches its maximum spread. It is perfectly obvious at night and probably acts as a signal between animals.

The most common sound uttered by roe deer is the gruff bark. The animals bark in alarm and the bucks bark a great deal during the rutting season. The doe has a whistling call which she uses to summon the buck or to keep in touch with her fawns. The fawns *peep* to the doe, a call which is more bird-like than anything else, but when alarmed or attacked they have a loud bleat.

Continental hunters call bucks within shooting range by imitating the whistle of the doe. Young bucks can be called more easily than older, craftier animals. Continental hunters use either a blade of grass or an artificial whistle to call up a buck. Sometimes a very poor imitation of the doe's whistle will bring a roe buck to the spot right away; on other days, no roe buck will answer the call and some will come only to a certain part of the territory.

Roe deer are not usually seen in big herds. In Britain, the usual company is a doe with fawns or a buck and doe with fawns and perhaps a yearling. Bigger groups are unusual. On the Continent, groups of four to ten animals are usual but sometimes large herds are seen. In the autumn of 1958, a herd of sixty animals was seen in the Trebon region of Czechoslovakia. In the eastern part of their range, for example in the Urals, roe form large winter herds and migrate along established runways westwards in search of slopes of clear snow. In spring, they make a return journey back to their home ground.

The **Siberian Roe Deer** is found in the North Caucasus in Siberia. This type has been introduced into Britain, as a result of which many British roe deer carry Siberian blood. The Siberian roe stands about 3 feet tall at the shoulder and measures about $4^1/_2$ feet in length. It has heavily pearled antlers, much bigger than those of the European roe. The ears are shorter and rounder and are long-haired on the inside. There is no white round the muzzle.

In the Far East there is yet another type — the **Manchurian Roe Deer.** It has small antlers and narrow ears which are thinly haired. It, too, is larger than the European species. It is found in Manchuria, Korea and China.

The Virginian deer of North and South America are similar to the Old World red deer. There are several races, none of which reaches the size of the European red deer. Mature animals stand from 35 to 40 inches tall at the shoulder. The antlers have no brow or bay tines. The beams are bent back and normally carry

Virginian Deer

five or six points. Colour varies from reddish-brown to yellowish-brown above, the belly and tail being white. The winter coat is greyish-brown. Fawns are reddish-brown at birth, spotted with white. Two or three fawns are born between the end of May and the beginning of July after a gestation period of seven months.

Brown Brocket

The **Virginian Deer,** also known as **White-tailed Deer,** are the best known North American species. They are found in Southern Canada, throughout the United States of America down to Northern Brazil and Central Peru, but are absent from the Pacific coast of the United States. Virginian deer have been introduced to several parts of Europe and in the forest of Dobris, near Prague, there are about one hundred animals. The Virginian deer does not bellow. It utters a hissing call which is heard mainly during the breeding season but outside it as well.

The deer of the Mazama group, known as the brockets, are found in South America where there are four species — the red brocket and three species of brown brocket. They are small but strong animals with unforked antlers forming simple spikes. They have no scent glands.

The **Brown Brocket** *Mazamo rufina* is found in thick forests from Guiana to Paraguay. It stands only 27 inches tall at the shoulder. It feeds at dusk and during the night and lies up in forest thickets during the day. It is found singly or in pairs and never forms herds. Very little is known about its habits.

The smallest antlered mammal of South America is the **Pudu.** It resembles the brockets in general appearance and has the same short antler spikes, but it lacks the whorl of hair on the face which is characteristic of the brockets. There are two species, the Chilean pudu and the Ecuador pudu. The Chilean pudu stands about $13^1/_2$ inches tall at the shoulder. The pudu of Ecuador is a little larger. The body colour of the pudus is red and brown with yellowish spots.

The **Chinese Water Deer** which inhabits China and Korea closely resembles the musk-deer. It is a primitive type without antlers. In its upper jaw it has the same large eye teeth, which in the case of the males protrude from the mouth. The toe glands are found only on the hind feet and there are no perspiration glands. This species is the only member of the deer family which produces a large family of up to five young. It lives singly or in pairs in thick cover near rivers. In its movements it resembles the hare.

Chinese water deer feed entirely on water plants. They are active throughout the day and lie up at night in reed beds or tall grass. When threatened they rely on concealment rather than on their running abilities. They run only for short distances.

The biggest of all living deer is the **Moose,** which is known in Europe as the elk. It has a big, elongated head with wide-cleft nostrils and a fleshy, overhanging upper lip. This alone is sufficient to distinguish the moose from any other species of deer, but apart from the unique, almost grotesque, shape of the head the moose is also unmistakable because of its size. A mature bull will stand 6 feet high at the shoulder and weigh over 1,200 pounds. The American moose is slightly bigger on average than the European elk.

The general colour of the moose's coat is greyish-brown, lighter on the legs and feet. The neck is short and strong with a mane and underneath there is the appendage known as the "bell". The blade-like antlers of the bull moose reach a maximum width of something over 6 feet and weigh about 44 pounds. Only the bulls have antlers, which are palmate and have a very short beam. The blades have

Pudu

tines or snags which may number twenty-eight to thirty in exceptional specimens. The shape of the antler blades varies, some being flat while others are concave. Some are carried on very short beams, others on long beams. Antlers reach their maximum growth when the animal is nine to twelve years old; then they begin to go back. Cows are smaller than bulls

Chinese Water Deer

and have much smaller hoofs and false claws.

Because of its long legs and short neck the moose is a browser rather than a grazer. It browses trees and bushes and enters the water to feed on aquatic plants, especially water lilies. During the summer months it spends much time in lakes and rivers feeding in this fashion. Although not gregarious in summer moose form larger groups in winter when they migrate in the so-called "moose yards", which are areas trampled out in the deep snow within reach of browse.

During the period of the rut in September and October, the bulls bellow to make contact with cows. The bulls are polygamous. Indian hunters and white hunters use a birch bark trumpet to imitate the call of a cow moose and thus summon a rutting bull within shooting distance. Calves are born in the spring after a gestation period of two hundred and sixty days. The adult bull moose is a powerful animal, well able to defend himself against pumas, wolves and bears by using his hoofs and antlers, but he is handicapped when the snow lies deep and it is then that young or weaker animals fall ready prey to enemies.

The European race of the moose is, as we have said, known as the elk, but the species has been much reduced throughout its European range by hunting pressure. The species disappeared from Central and Southern Europe in the thirteenth and fourteenth centuries. The last moose in Poland was killed in 1888. At one time, the moose existed all over Europe to the Pyrenees and Northern Italy, as the discovery of skeletons from the Ice Age prove. As a result of protection in Scandinavia and European Russia, the moose is again gaining ground and is once more established in Northern Poland. In 1957, a young bull moose appeared in Czechoslovakia in the Litomerice region and was almost certainly one of the animals that had been set free by the Poles near Warsaw. So, it had made a very long journey south. This young moose bull was regularly seen near Litomerice for a long time and the gamekeepers considered it their protégé. Its presence was widely reported in newspapers and magazines, then on 6th September, 1958, it was killed by a gamekeeper in mistake for a red deer.

Northwards in Europe and European Russia, the moose is found to the limit of the forest. The southern limit of its range varies and is of course influenced by man. In Asia and North America, it is found mostly south of 43°N. latitude. In many countries it is now protected because of its economic and scientific importance. In the Scandinavian countries its shooting is either completely prohibited or limited. Protection in Scandinavia and European Russia has resulted in an increase in numbers, and in recent years the animals have been spreading their range southwards. They are now present in Southern Sweden and Northern Poland and have been recorded on the Danish coast which they reached by swimming from Southern Sweden. In the Soviet Union an open season has again been introduced for moose and a ten per cent. cull of the herds is carried on under special licence. Moose have strayed into the suburbs of Leningrad and have been observed in public parks there.

Most of the antlered mammals can be described as handsome but this cannot be said about the moose. It is powerful but clumsy and ungainly. An interesting feature about moose antlers is that some

individuals have antlers without blades. Throughout their lives such animals remain one-pointers and in some cases the antlers even branch. Animals with such antlers were for long regarded as a special type. These unusual antlers might well be regarded as more useful than the heavy, normal, palmate type, which must be more a nuisance to the moose than anything else. Adult bulls shed their antlers in November and December; younger bulls shed later, in January and February. Many races of moose have been described on the basis of antler type, body weight, or slight physical differences, but, nowadays, all moose are regarded as one species with several geographical races, three in Europe and Asia and four in North America.

The moose prefers open to closed forest with an abundant water supply and, especially, bogs and lakes with plenty of water plants. In summer, it spends much of the day in shallow water to keep cool and protect itself against the flies. In winter, it chooses its ground according to the depth of the snow. When the snow reaches a depth of 23 to 27 inches, the animals migrate to the places where there is a thinner snow cover.

Although the moose browses twigs and leaves and feeds to a great extent on water and bog plants, it also strips bark at times. It can denude a large area of a tree by pulling the bark sharply from the bottom. Where moose numbers are too high, considerable forest damage can result.

During the summer months, the bulls and the cows live apart. The mating period starts about the end of August but sometimes later. The onset of the rut is affected by latitude and climate. During the rut, the bulls smell strongly and their meat cannot be eaten. At this time they eat little but drink a great deal of water. Old bulls gather a number of cows but younger animals usually have only one and do not play an important part in the rut. Rutting takes place in open areas of the forest and there is much fighting among the bulls. The young are born in May or June of the following year. Young cows have only one calf at a birth, older animals have two or three. After two days the calves begin to follow their mothers. Moose calves are unspotted at birth. The very young moose calf, because of the mother's size, suckles her when she is lying down or in the kneeling position. The calves grow very quickly and at the age of one month begin to graze. At the end of the year the calves and the moose cows assemble to move out for the winter. At this time the bulls live apart.

In Europe, the moose change their ground according to the season, migrating to the plains in winter and to the mountains in summer. In the Taimyr region in spring, they move from the forests northwards to the tundras, then southwards in autumn to the wintering grounds. The migration of the moose can thus be compared with that of the reindeer.

Moose

Moose become sexually mature at the age of three years and six months and can live to the age of thirty or forty years. The main predators are man, wolves, bears and, in Eastern Siberia, tigers.

Stalking the world's biggest deer is an unforgettable experience because it is carried on against such a spectacular background. The writer, Luskac, tells about his moose-hunting experiences in the Soviet Union:

"At one point we set off in different directions. The two Russian hunters went along the left slope of the valley and I and my dog, Murka, went along the right slope. We were separated by a meadow which is about 3 miles long and half a mile wide. We had been walking for about fifteen minutes when I heard noises on the far slope, followed by the barking of dogs and then four shots. I had to grab Murka's collar to prevent her rushing to the opposite slope from which we could hear the barking of the dogs. Murka was a very obedient dog and the slight tap was sufficient to let her know that she had to remain silent and follow me. I ran to the edge of the forest and carefully examined the meadow. My calculation was correct. No sooner had I reached the edge of the forest than I saw three moose coming from the opposite slope. They were running noisily, breaking small bushes and trees. A handsome bull was leading with his head held high. He had wide blade-like antlers or statues as they call them in this country. This powerful bull was followed by two other moose and this was the first time I had ever seen these animals in the wild state. My hands and legs were trembling. I grasped my rifle, gritted my teeth, and prepared to drop the magnificent animal which could have shattered my skull with a hoof stroke. My dog, however, could not stand it any longer — she tore away from me and ran across the meadow in the direction of the moose. The leading bull took no notice of the dog and merely shook his head at the small intruder trying to bar his path. I grasped the rifle still more firmly and waited a few moments so that I might remember this wonderful sight. I aimed at the heart of the master bull. The moose was now running towards me. I stood among the bushes and pulled the trigger, and before the echo of the shot died away the moose had stopped running. It stood there on the snow-covered ground, shaking its antlers as though to ward off some deadly foe. My second shot hit it directly on the head and it fell to the ground."

Many efforts have been made to domesticate the moose as a draught animal. If it could be trained to pull sledges or carts it would be much more useful than the reindeer because it is a much stronger animal and faster. Generally speaking, the attempts were unsuccessful, although in a few cases encouraging results were obtained. The moose pulled loads all right and multiplied in captivity, but even tame moose love water and it often happens that a moose drawing a cart alongside water would suddenly swerve away from the road and wade in. It was found to be impossible to stop moose from doing this or from wallowing in the mud.

Moose are rarely kept in zoological gardens.

The **Reindeer** differs from all the other deer in the world in that both sexes have antlers. Females can usually be distinguished from males by their smaller and less branched antlers, but very old cows can develop antlers like a bull. Reindeer

antlers turn backwards from the skull over the head and then curve forward again, forming a ring. The reindeer is much smaller than the red deer and does not weigh more than 3 hundredweights. Its thick fur is grey and brown in summer and whitish-grey in winter. The fur on the front of the neck forms a mane which sometimes reaches down on to the chest. The reindeer is the deer of the Arctic and sub-Arctic areas and is known in North America as the caribou. It disappeared from the British Isles towards the close of the twelfth century, probably exterminated by excessive hunting. In 1952, an experimental herd was introduced into the Cairngorm area of Scotland, and a small herd is now established there.

Reindeer live to a very great extent on a lichen, the so-called reindeer moss, but they eat other food as well, including grass, herbs and the twigs of stunted trees and bushes. In older zoological text books, it was often said that the reindeer uses its brow tine for uncovering lichens buried under snow. This is not true. It uncovers the so-called reindeer moss by scraping down to it with its hoofs.

Although reindeer live mainly on the vast treeless tundra of the far north, they are also found in forested areas and on mountains. In the Ice Age, when the whole of Europe was colder than it is now, reindeer ranged over most of Europe as well, a fact which is proved by the discovery of skeletons in widely separated areas. Their range extended to the Mediterranean. As the climate became warm and the glaciers retreated, the reindeer withdrew to their present range. In the past hundred years, the southern limit of their range has been changed largely by the influence of man. In Europe and Siberia for example, the animals were

Reindeer

pushed far to the north of their former natural boundaries. This adjustment began in the middle of the nineteenth century. At the same time, their numbers decreased.

Estimates of reindeer numbers have always differed widely and were always rather high. The late Ernest Thompson Seton estimated during his 1907 expedition that there were thirty million in the Canadian tundras. Other experts agreed with him that they were more numerous than the bisons had ever been. In 1930, W. H. Hoare, a government expert, estimated the number of Canadian caribou at five million.

At the present day there are about 670,000 reindeer in Canada. In Alaska their number varies between 25,000 and 1,000,000. In the Soviet Union there are about 2,000,000, and in the Scandinavian countries, 500,000, including domesticated stock.

Reindeer are gregarious animals and

live in herds throughout their lives, except for very old males that become solitary. Cows, calves and immature animals herd together during the summer; the bulls form smaller groups, and the herds live separately. With the coming of winter, the herds join together to form bigger ones numbering hundreds or even thousands of animals. In each herd there are two distinct groupings — the animals on the fringe, the so-called edge reindeer, and those forming the core of the herd.

The reindeer of the vast northern tundras migrate twice a year. In Europe, where their range is more limited, this migration is not spectacular, but in Siberia and North America the animals cover hundreds of miles between their wintering and summering grounds, following the permanent trails used by their ancestors and overcoming many obstacles on the way. What prompts these seasonal movements is still not completely clear, although they are obviously influenced by winter food supply. But there may be other and more complex reasons. In Canada, up to 20,000 animals have been known to pass through one area in a day, but these spectacular movements now belong largely to the past as the species is decreasing everywhere. A Norwegian hunter and writer has described the migration of reindeer as follows:

"An experienced cow leads the herd and is closely followed by a bodyguard of powerful bulls. Behind this spearhead the other members of the herd move in an endless stream. From time to time, the herd breaks up and the animals scatter over the landscape. At other times they crowd so closely that it is not possible to distinguish one beast from another. The antlers clash and clank in rhythm. The leading cow guides the herd along the immemorial trails as unhesitatingly as though she had a map of the area, using the passes and fords used by her kind since ancient times. Many animals are left behind with their legs broken, hundreds drown in river torrents, but nothing can hold up the forward surge of this mighty army. Wherever one looks, in rivers and lakes, or on the vast tundras the reindeer are moving forward, a surging forest of antlers.

"The migrating herd has its followers waiting to pick out the stragglers, the weaklings, the injured, and the dying. The wolf packs tread in their slots and the crows circle overhead. Heading each wolf pack is an old, experienced animal who knows how to cut out an animal from the herd. Once this has been accomplished the wolves surround it and pull it to the ground. After eating their fill they move on in the wake of the herd. Other wolves following on clear up the remains of carcasses and kill off wounded animals and strays. The crows follow the wolves, circle about while the wolves are killing, then settling in a black cloud to feed on what they leave. Later still, the white foxes arrive in packs to scavenge, and lone wolverines can be seen sneaking among the rocks."

The reindeer is still an important animal to certain northern tribes, providing the people with excellent meat and valuable hides. When the animals, as sometimes happens, change the direction of their migration and fail to appear in the accustomed places where the hunters are waiting for them, this can mean disaster for whole Indian tribes.

The rut takes place in the autumn. At this time the bulls become very restless, fighting each other and gathering a harem of up to twenty cows which they defend

against their rivals. The calves are born after the herds return to their summering ground. One calf is usual but in rare cases a cow may give birth to twins or even triplets.

In the far north, man does more than hunt the reindeer: he herds them as semi-wild domestic animals. The herds provide him with meat, hides and rich milk. In Scandinavia, the animals are used for pulling sledges and in these regions they are the only draught animals. Reindeer are reliable and persevering runners, and a good draught animal will cover 90 miles a day with a load of over 100 pounds. In the past, the reindeer has made it possible for people to live in inhospitable northern regions, but modern techniques and the improvement of transport in these remote areas are making reindeer, wild and domestic, less and less important.

GIRAFFE AND OKAPI
Family GIRAFFIDAE

The giraffes are a special group of even-toed ungulates. In some ways they are very like the antlered animals; in others they are more like the bovines. Their size, their horns and their short fur suggest that they are closely related to the bovines; on the other hand, certain characteristics of their skull show that they are related to the antlered group. Although the giraffe's skull resembles that of long extinct mammal types, the skeleton of its limbs is like that of modern types. Giraffes resemble camels in having no side toes. The horns are hollow, bony protuberances covered with skin. In the case of the true giraffes, the skin covers the whole horn except for the callous at the tip. In the case of the okapis, the tips have naked, bony caps. Besides the main pair of horns, males can have another pair above the eyes and a single horn on the forehead. There are no eye teeth in the upper jaw; the lower eye teeth are closely attached to the incisors and their crown is divided into two protuberances.

The giraffe's body is comparatively short, but it has long legs and a strikingly elongated neck. The hind legs are much shorter than the forelegs so that the animal's back slants steeply towards the rump. In the okapi, the back slants very slightly. Although the neck of the giraffe is so long, it has the same number of vertebrae as a man's or whale's. The individual vertebrae are, of course, much longer.

The **Okapi,** is the only living relative of the true giraffe and is found in the depths of the Ituri-Semliki forests of the Belgian Congo. It was unheard of until the year 1901 and Sir Harry Johnston, the governor of Uganda, was the man who produced the first evidence of its existence — two skulls and a skin. Sir Harry recorded:

"It has been one of the surprises of the twentieth century that a mammal so large and so eccentrically coloured could have remained unknown to science down to 1901."

Although it has neither the giraffe's elongated neck nor its great length of leg, the okapi is similar to it. It is as big as a horse and although its neck is short compared with the giraffe's, it is long in comparison with that of other animals. It

has long, prominent ears. The males have horns about three inches long which point backwards; these are made of bone covered with skin and grow behind the eyes.

The general colour of old males is red and brown; that of females and younger animals is black and brown. On the lower rump and hips are black and white stripes. The lower part of the legs is white, then black, followed by a white ring above the hoofs. The horns are usually completely covered with skin, but in the case of old males the bony tip protrudes for about half an inch beyond this covering.

The okapi escaped discovery until modern times because of its shy, retiring habits and the inaccessibility of the forests in which it lives. But is it a rare animal? This does not follow and Machulka has written:

"It is not. It is limited only to a certain region. I have formed this opinion after taking the traces of the animal in the Ituri region into consideration. Other experienced hunters and zoologists are of the same opinion. The shyness of the animal and its hidden life in the jungle make it seem very rare and it is on the list of strictly protected animals. I think this is rather superfluous as most hunting comes to nothing. The natives hunt it in primitive ways and so long as they continue to do so by traditional methods, the okapi will never be exterminated. It lives in the jungles on higher and dry ground, avoiding humid undergrowth, bogs and other soft ground. It is not fond of thick undergrowth. Its chocolate colour, together with the stripe on its rump, camouflage it perfectly in its surroundings. Because it avoids soft ground it is a difficult animal to track. It walks mainly on dry leaves and only the pygmies know how to find and follow its footprints. They observe carefully the position of the disturbed leaves and like a retriever they sniff the footmarks. The animal never uses the paths of other species. It will cross them but otherwise it will avoid them completely.

"In the sunnier parts of the jungle, where there is thin, high, second growth, the okapi feeds in the morning and evening. It spends the rest of the day resting on higher ground where there is absolute silence, its ears alert for the slightest sound. Its eyes are also good and it can detect the slightest movement. Its sense of smell is also highly developed. Usually the okapi lives singly or in pairs, but where there are tracks of one there will be tracks of others. Once I found two kinds of footprints, one set being those of a young animal.

"The okapi feeds on leaves and the shoots of young trees and shrubs. It reaches up for twigs and plucks them with its tongue in the same way as the giraffe does. Its droppings are always deposited in a single heap and are never dispersed. When fleeing from an enemy it will leap over obstacles and never crawls under them as buffaloes or jungle antelopes do. I have never found any ticks or parasites on the body of a newly-killed okapi."

In 1953 a hunting station was established in the Kibali-Ituri district for catching okapis for zoological gardens. The head of this station has a proved method of catching them without incurring big losses. At this station, young animals are also being caught with considerable success.

The okapis are caught by pygmies from local tribes. Captive animals often adopt and nurse newly-caught young. Dr. Lang noted for example that female number 30 had one young to which she gave

birth in captivity, but adopted two other young newly brought in from the jungle. She reared all three. However, when she was given a fourth young animal she refused to accept it. As soon as the young animal tried to suckle her she drove it away. The young animal crept through a hole in the fence into a second corral where it began to suckle another female which had just given birth to a single young. Dr. Lang presumes from this behaviour that the relationship between old and young okapis is not so individual as in most other mammals.

It is an interesting fact that a captive okapi shows considerable anxiety when pygmies enter its corral. Apparently there is an inborn fear of the primitive native hunter. On the other hand, the animal is not nearly so afraid of white men.

The **Giraffe** resembles no other living animal. It is the tallest of all, standing 9 feet tall at the shoulder and 18 feet to the top of its head. Its most striking feature is its long neck. The body is short in relation to the animal's height and measures only $7^1/_4$ feet from chest to tail. The back slants steeply towards the tail which ends in a tassel about 3 feet long. The tongue reaches a length of 17 inches.

Twelve races of giraffe have been described, the distinctions being based on colour and markings. The general coat colour of the giraffe is cinnamon brown with darker spots, triangular or star-shaped. The spots disappear below the hocks and knees. The fur is short and tight. On the neck and along the whole of the back there is a short, dark mane. The horns on the skull point backwards and are covered with skin. The bony part of the horns is attached to a protuberance on the skull. The horns remain covered

Giraffe drinking

throughout the animal's life, and are therefore unlike the antlers of deer or the horns of other ruminants. In some cases, there is a second pair of horns behind the main ones and there may be yet another on the forehead. The number of horns present helps in identifying the different races.

Giraffes have narrow heads which are elongated into soft muzzles. The ears are not so striking as the okapi's The eyes are large and dark. Because of its long limbs and long neck, the giraffe has to splay its forelegs to reach the ground with its mouth, for example when it is drinking. Like the camels, the giraffes are amblers. That is to say, the fore and hind legs of each side come forward at the same time.

Until recently, many of the races of giraffe were looked upon as separate species, but the most recent research has made this view untenable. All giraffes belong to the same species. Different races will breed together in captivity and they do the same under natural conditions. In the case of such crosses, the characteristic features of the parents disappear.

The reticulated giraffes have large spots on their bodies and there are no spots below the heels. These giraffes have up to five horns. The best known race is the **Reticulated Giraffe** which is found

Reticulated Giraffe, Nubian Giraffe, Cape Giraffe

in Kenya, Eastern Ethiopia and Somalia.

The second group lives to the south. The animals of this group have dark, star-shaped spots. They have usually only two horns. To this group belongs the **Cape Giraffe** found in South Africa, and the **Nubian Giraffe** found from Nubia to Western Ethiopia.

Dr. Ullrich, describing the hunting of giraffes, also mentions their strange movements:

"The giraffes are still in the distance and it is surprising how guileless they are. Of course for a very long time they did not regard man as their enemy. They are not hunted here because they are protected in East Africa. This explains their tameness. Therefore the car used in catching is soon driven round them and they are pushed out on to the plain, clear of the trees. The driver now accelerates and in a moment or two the car is in the middle of the herd. The giraffes break away at an ambling gait, then begin to make great leaps. It is an indescribably beautiful sight. The heads and necks remain almost motionless as the animals cover the ground, straining every muscle. Dust, stones and turfs are tossed into the air, kicked up by the hoofs of the retreating animals."

At one time, giraffes were found over large areas of Central Africa and in the whole territory of South Africa. Now they are confined to East Africa, from Nubia southwards to the Orange River and westwards to Nigeria and Angola. They are typical inhabitants of African plains with a thin cover of tall trees. They are not grazers; they feed mainly on the twigs of trees.

Dr. George Baum has written about giraffes:

"They are strange animals with a sort of baroque elegance. Their neck seems to be located far back and their brilliant cinnamon colour stands out in contrast to the grey and green of acacia trees. The giraffes stop to look towards me, then continue browsing the tops of the young acacias. From time to time, their long, blue tongues protrude to gather young shoots, which are then drawn into the mouth. For the giraffe, the tops of the acacia trees are like a spread table. The pictures in the old zoological text books, showing how the poor giraffe has to spread its legs in order to eat the grass, misrepresented the facts. Giraffes do not feed on grass.

"I have seen giraffes most frequently in small herds consisting of four or eight animals. In former times, however, the situation was quite different and olden travellers mention large herds of these animals. That, of course, was before the arrival of modern weapons in Africa. The giraffe has almost no natural enemies unless perhaps the lion, but it is still not certain whether a lion would dare attack

XII 1. *Okapi* 2. *Pronghorn* 3. *Bongo* 4. *Cape Giraffe* 5. *Giant Kudu* 6. *Eland*

such a large quarry. Dr. Livingstone did not believe it. Gromier recorded that he had seen several carcasses of giraffes which had been killed by lions. I once saw a giraffe standing motionless with its ears hanging down, and this might have been one which had just routed a lion. The giraffe defends itself by kicking with its hind feet and such a kick might be enough to deter even the boldest lion. I know a case of a car driver who tried to drive close to a giraffe that was standing at the side of the road. He succeeded, but the giraffe kicked out with such force that it damaged the radiator and pushed back the car's engine fully 2 inches."

Other authors say that the giraffe also uses its front legs when defending itself, and will kick with fore and hind feet as required. A giraffe has been known to crush the skull of a lion. Males when fighting with each other try to use their horns, so it is wrong to say that these are not used for any purpose.

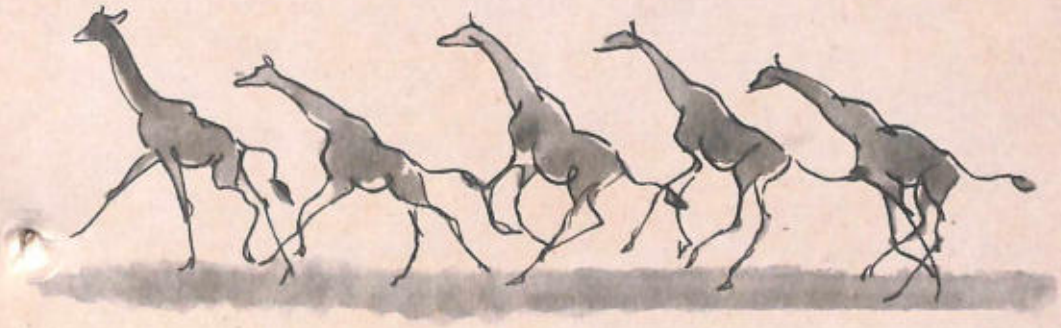
In the big African reservations, where the giraffes are protected by law and are not harmed, they are easily approached. This is not so easy if the giraffes are accompanied by the oscine birds which perch on their backs and collect various parasites from the skin. The birds warn the giraffes by uttering loud cries or by flapping suddenly into the air. Dr. Baum describes this association:

"Once I was observing a solitary giraffe with eight oscine birds on its body. Birds were arriving and departing and the giraffe's neck looked like the limb of a tree with birds perching on it. At one moment the giraffe was standing completely still while one of the birds was hanging to its lower lip as if trying to look into the animal's mouth."

Under natural conditions, the neck of the giraffe is extremely strong. Captive animals usually have weaker necks because they are not so well nourished.

During the breeding season the male giraffes fight, using their necks and heads. A mature male is usually in charge of each small herd. One young is born after a gestation period of fourteen or fifteen months. At birth, the young animal measures from $5^1/_4$ to $5^3/_4$ feet in length. At the age of six months, it reaches a total height of 9 feet.

The greatest enemy of the giraffe is man, who kills it for its skin and meat. If it were not protected by law it would very likely soon become extinct. In any outbreak of disease, giraffes are usually among the first victims.



The gait of a giraffe

We now come to the family of hollow-horned ruminants. Although the words horns and antlers are often used to describe the same thing, it is more correct to use horns for this group and antlers for the deer family. Antlers are made of bone and are regrown and cast each year. Horns, on the other hand, have a bony core but the sheaths are composed of hard skin or horn. This skin is never rubbed off and the horns themselves are permanent. Horns are usually bent or upturned and are seldom straight. Their growth is influenced by a number of factors and show rings of growth which can be compared with the annual growth rings of a tree. The rings of the horns can therefore be used in telling the age of animals with a certain degree of accuracy.

The hollow-horned ruminants have no incisors or eye teeth in the upper jaw. The lower eye teeth resemble the incisors and are closely attached to them. There are three molars with a high crown and a short root in each jaw. The grinding surfaces have four crescent-shaped protuberances.

The species in this family are usually, but not always, gregarious. Many species are of great importance to man, either for hunting or as domesticated animals. Some are used as draught animals and provide man with meat, hides and horns.

PRONGHORN

Family ANTILOCAPRIDAE

Unlike all the other hollow-horned ruminants, this group has branched horns and sheds them: The Antilocapra form a link between the horned and antlered mammals. Their horns are forked and are cast and regrown each year. There are no false claws. The skin glands are situated under the ears, in the lumbar region, on both sides of the tail, and above the heel joint. There are no glands under the eyes. It can be assumed that this family deviated from the main stream of ruminants a long time ago and is an independent type.

There is only one species of this family in existence — the **Pronghorn.** It resembles a medium-sized antelope. It stands from 30 to 35 inches tall and is 5 feet in length, including $7^1/_4$ to 8 inches of tail. Its broad head tapers into a narrow muzzle and there is a bulge round the eyes. The body is covered with long, rough fur, which is longer still on the back and in the lumbar region. Males have a mane about $10^1/_2$ inches in length.

The pronghorn is red and yellow above and white below, the white extending to the middle of the flank. The throat and the lower parts of the limbs are also white. The rump patch, which is long-haired, is also white. These hairs can be erected, thus increasing the area of the rump patch. As in deer, the rump patch is spread wide when the animal is excited or afraid. The large rump patch is a signal to the other members of the herd that there is cause for alarm. Males and females have horns. In the case of the males, these are from $9^1/_2$ to $11^3/_4$ inches in length; they are wide set and rough on the surface with occasional protuberances. The horns of the females are about $4^1/_2$ inches long.

The pronghorn is found in North Ame-

rica between 23° and 53°N. latitude. It was once a common animal in western North America but its numbers have decreased with the spread of civilisation. The species is now confined to hilly regions. American zoologists have described several races of pronghorn of which three are at present recognised. One of these is found in Mexico, the second in California and the third in the area between Missouri and the Rocky Mountains. According to the biological survey published in 1922 and 1925, there were about 30,000 pronghorns in the United States, Mexico and Canada, living in two hundred and eighty-six herds. There are detailed reports by American zoologists dating from the time when pronghorns could be seen all over the vast prairies. One such report was by Audubon, who wrote:

"Now we are observing a herd of these wonderful animals. They are not much afraid of man. They suddenly stop running and with heads held high turn their ears and eyes towards the hunters. They stamp the hard ground with their forefeet, their hoofs making a great deal of noise. Within a short time, they seem to realise that the hunters are dangerous and start turning away like a flock of startled sheep. Their speed is much greater than that of sheep and the young kids are able to keep up with their mothers. Very soon, they form a wide circle at a steep hill where they stand staring at the hunters."

Confield has written about the pronghorn:

"From the 1st of September to the 1st of March they can be seen in large groups, formed of males and females with young. At the end of this period, the herds break up and the females give birth to their kids. After some time, the females and kids form into a herd again so that they can better protect themselves against wolves. Old males are now running alone or in pairs. Younger males and females form herds of their own. The males wander widely for a month or two at this season and thus appear in regions where they are not seen at other times of the year. After two or three months, the younger males join the nursing females and their young. Finally, the old males rejoin the herd too, so that from 1st September onwards herds of one hundred to one thousand animals can be seen. The animals do not leave the area of their birth and the distance they cover is never more than a few miles."

Everyone who saw the pronghorns in their natural state admired their speed. The pronghorns, always alert, choose

Pronghorn

their resting places with care, always lying up in a place that gives them a view over a wide expanse of country. It is an interesting fact that they fled, not only from carnivores and man, but from bison and red deer. The mating period of the pronghorn is in September when the males fight each other and gather a harem of ten to fifteen females. The young, usually twins, are born after a gestation period of eight months. Pronghorns can reach the age of twelve to fifteen years, but the average life span is about eight years.

The pronghorns shed their horns in October and the growth of the new horns is complete in July of the following year. The permanent, bony core of the horns is not shed, only the sheath.

Pronghorns are fleet, active animals, and speeds of up to sixty miles an hour have been recorded on hard, level ground. Their main enemies are coyotes, but bobcats kill a certain number of kids.

SPIRAL-HORNED ANTELOPES, CATTLE, GOATS, ETC.
Family BOVIDAE

In this family are the antelopes, sheep, goats and cattle, including domestic cattle. The horns of this group are never shed. They grow throughout the animal's lifetime. Some are straight, others bent backwards, to the sides, or even ring-shaped. Almost all of them have only one pair of horns, the Indian antelope being an exception. The family is divided into several sub-families.

Cattle are stout, powerful animals with wide mouths, bare, moist muzzles, and big nostrils. The horns grow from the top of the head and tend upwards. Cattle differ from antelopes in the location and direction of the horns. The long tail, ending in a thick tuft, reaches almost to the heels. The teeth have special features. The inside incisors are wider than those at the sides. The molars are column-shaped, the rear molars being the largest. The masticating surfaces are big. The hair is short and tight.

Cattle are, or were, found mainly in Europe, Central and South Asia, Africa and North America. Many have been domesticated by man and can now be seen throughout the world. They feed on various species of plants, the twigs of trees, grass, herbs, bark, mosses and lichens. Some live in forests, others on steppes or in mountains up to a height of 16,000 feet. Many of them are nomadic, forming large herds and covering great distances in search of food. Although generally docile and peaceable, they know how to defend themselves with their horns when danger threatens, and the African buffalo is regarded the most dangerous animal on that continent.

Indian buffaloes are not even afraid of the tiger. Most of them bellow like domestic cattle, but some of them also grunt. The females have four teats and usually give birth to a single young.

The **European Bison** is the last living wild species in Europe. It is about 11 feet in length, stands 6 feet tall at the shoulder and weighs between 9 and 14 hundredweight. The short, round horns point upward and forward from the head. The woolly hair is very thick and becomes long and curly in winter. It is long on the top

of the head and hangs over the forehead. The long mane on the neck spreads under the neck and on to the shoulder. Under the chin, the long hair forms a rough beard.

The European bison resembles the American bison in general body shape. It carries its head somewhat higher than the American species. It has the same hump back and its body slants towards the rump, but neither its hump nor the slope of its back is as striking as in the American bison. The hump of both the European and American bisons is not an accumulation of subcutaneous fat, it is formed by special thorn-like protrusions of the vertebrae of the chest. The cow of the European bison is smaller than the bull. Her horns and mane are thinner and she closely resembles our domestic cattle. The general colour of the European bison is chestnut-brown with the sides of the body black and brown.

Formerly, the European bison was found in large numbers in the forests of Central and Eastern Europe. It was found in France, Germany, Austria, Hungary, Poland and eastwards. Because of the protection laws passed by Czar Alexander the First, the European bison survived on the Polish-Russian border until 1914 when there were still about one thousand animals in the area. All of these were killed off during the First World War. By 1927, the species had been exterminated in the Caucasus. In Upper Silesia, three wild animals survived and there were forty-five in zoos. The species was built up again from these two sources and by 1949 there were 119 European bison living in zoos and parks. The Second World War caused almost no losses among the European bison. According to the census of 15th January, 1951, published in 1952, there were 135 European bisons living at that date. About ten animals die each year and about twenty young are born, so the species now seems to have a safe future.

European bison become physically mature between the eighth and tenth years of life, although they are sexually mature at three years old. The life span is about 20 years, in exceptional cases 27 years. The cow gives birth to one calf after a gestation period of 270 days and two-thirds of all births take place in May or June. The calf is much lighter in colour than the adults.

The adults live in herds and each herd is led by an old cow. Mating takes place in August and September when the bulls fight with each other. As soon as this is over the bulls seek the depths of the forest where they lead a solitary existence. European bison, unlike the American species, are forest animals and not numerous on the plains. As a result, they form small groups and are not found in large herds. As a general rule, forest animals live a more solitary life than those of the plains.

Compared with the American bison, the European species is a slow breeder. The cows do not all breed successfully. They age quickly and soon stop giving birth to young.

The **American Bison** is a giant among North American mammals. Bulls stand $5^1/_2$ to 6 feet tall at the shoulder and weigh from 11 to 20 hundredweights. Cows are smaller and lighter. The American bison is heavily and powerfully built in front and has a large head carried low. It is an impressive animal with its bleary eyes, short horns, wide forehead and thick mane. This bison has a pronounced hump and the body tapers

quickly to a weak rump. The massive, imposing front is accentuated by the mane and the curly hair of the head.

The summer coat of the American bison is much shorter than the winter one. The winter coat is shed quickly and in the transition period the animals are patchy and look as though they were suffering from mange. The hair is uniformly dark-brown; the horns are small; the hoofs, muzzle and horns are black. Despite its bulk, the American bison is a much faster animal than domestic cattle. When galloping it is said to be almost as fast as a horse. In addition to being a first-class runner, it is a fast, skilful swimmer.

The history of the American bison provides one of the worst examples of human predation on a species and is exemplary so far as the protection of wildlife is concerned. Before the white man arrived in America, the bison roamed the prairies in great herds, covering a territory from the Atlantic Ocean westwards to the frontiers of Nevada and Oregon, between 25° and 65°N. latitude. They provided the main food supply of the North American Indians, who hunted them with bows and arrows. The Indians killed many thousands of them every year for their meat and hides. Surplus meat was preserved by drying and provided the Indians with a winter food supply. This annual cropping of the bisons by the Indians made no impression on their numbers. The coming of the white man changed all this: he was a killer, not in the least concerned with the reasonable exploitation of a natural resource or husbanding it for the future. As a result of killing by white colonists, the number of American bisons declined year by year and the Indians saw their food supply gradually disappearing. The decline of the bisons meant the decline of the Indians as a force.

The white hunters took up what they called their stands and their aim was to kill as many bisons as they could. A good shot, working by himself, could kill between 1,600 and 3,000 animals during a single expedition. The hunter, Jack Bridges, killed 1,142 bisons in a period of six weeks. Buffalo Bill Cody was one of the greatest killers on the American continent. Such killings were made possible by the use of heavy, long-range rifles. The killing was made easier by the fact that the bisons were dull-witted animals and learned nothing from the continued killing. According to Hornaday, a good shot could kill dozens of animals at a range of 200 to 250 yards. A hunter named Andrews killed 63 animals in less than one hour, shooting from one spot. Another hunter killed 91 in one area. Dodge has recorded that another hunter killed 12 bisons in less than three-quarters of an hour.

At the beginning of the nineteenth century, there were ten million bisons in America. By 1871, with the spread of modern shooting weapons among the Indians, the number had been cut in half and the bison herds were split up into isolated territories. According to the information available, the southern herd numbered about three million animals. The animals were killed to feed railway workers, and for their tongues and hides. The construction of the Pacific Railway, which was completed in 1869, contributed greatly to the destruction of American bisons. In the next four years, the southern herd disappeared completely and the northern one was killed out shortly afterwards. By 1881, only 85 wild bisons remained alive in the United States of

America. In Yellowstone Park there were about 200 animals and in Canada, 550. In the year 1903, 960 bisons remained in forty-one states of North America.

The protection of the remaining bisons was taken over by the American Bison Society which was formed for this specific purpose. A number of private persons assisted in the attempt to save the bisons from extinction. One of these was a man named Dooley who bought Antelope Island in the big Salt Lake and turned it into a reserve for American bisons. He brought 26 animals to Antelope Island. Thanks to all these efforts there were 4,376 animals alive in 1926. By 1936, their number was estimated at 25,000 head and at present there are about 30,000 bisons living in the big reservations or in zoological gardens.

Of all the hoofed animals the American bisons were the most gregarious and they lived permanently in big herds. In winter, driven by cold and scarcity of food, they migrated southwards for over one hundred miles. There was a reverse migration northwards during the hot summer months. These herds, made up of many thousands of animals, followed regular trails known as buffalo paths, which had been used by their kind since time immemorial. Dixon gives some idea of the vast numbers of bisons that once lived in America:

"In groups, herds and masses, these black, curly-coated animals were stamping past us. We saw them for forty hours in front of our eyes, thousands upon thousands, ten-thousands and hundreds of thousands of animals — a mass which could not be counted altogether — natural herds of untamed animals, the meat from which could fill the wigwams of the Indians for all eternity."

The old zoologists tell us in their books that the big herds of American bisons scattered over the prairies were made up of smaller groups. It is interesting that the group of cows led by younger bulls formed the outer fringe and protected the great herd. Even the old bulls did not lose their sense of community and formed part of the herd. They never separated from them as other ruminants do. The old cows did not leave the herds at calving time between March and June. The cows give birth to a single calf after a gestation period of nine months.

Apart from the white man, the bisons had other natural enemies, mainly wolves and Indians, but their numbers were unaffected by the predation of either. The biggest natural calamity for the bison herds was bad weather, and during severe spells of snow, hundreds of animals died of starvation. It can now be safely said that the American bison has been saved. Their present numbers guarantee that they will remain as part of the American scene and a monument to the free, unfettered life of the American Indian. Many other species are now in a dangerous position and are far worse off than the bison because we know that they will eventually disappear from the face of the earth.

The **Yak** is the most hairy member of this group and lives mainly in the high mountains of Central Asia where icy winds blow throughout the year and the snow lies permanently. The animals are perfectly adapted to this rough environment and are protected from the cold by their warm fur.

The yak is a powerful animal, about 14 feet long and standing 6 feet tall. It has a narrower head than the American

bison and is a shorter animal. If shorn of its long hair it would resemble domestic cattle. Its horns are more widespread than those of the American or European bison. They project forward from the head and then turn backwards. They are about 3 feet in length. Old bulls weigh between 12 and 14 hundredweights. Cows are shorter and smaller and their weight is less than half that of the bulls. Their horns, too, are much shorter. The tail in both sexes is long-haired and resembles that of the horse. The hair is long and soft, curly on the forehead. On the back and sides of the body it forms a long mane which in the case of old bulls reaches to the ground. The general colour is black and brown.

In Tibet, the yak has been domesticated for many centuries, but it still exists as a wild animal in Tibet and Kansu, living between 14,000 and 20,000 feet. Formerly it was much more widely distributed as a wild animal.

When Przewalsky and Hedin made their memorable expeditions into Tibet the wild yaks were still living everywhere on grassy mountainous plains and in semi-deserts. The present-day wild herds are small, although the vast mountain pastures could carry the former large numbers. Little is known about the life of the yak as a wild animal. The biggest herds exist to-day on the best pastures, usually near water. Old bulls lead a lonely life, but the cows, young bulls and calves join into big herds numbering up to several thousands of animals. During violent storms, or under threat of danger, the animals flock together, with the young in the middle of the herd. If a hunter approaches or fires a shot, the whole herd starts running. When running at full speed, the yaks lower their heads and put up their tails. They run without looking round, retreating in clouds of dust. The thunder of their hoofs can be heard a great distance away, but such headlong flight cannot last and the fleeing herd rarely runs for more than half a mile. They slow down and the old order prevails again, the calves in the middle with older animals forming a living wall around them.

The wild yak can climb hills and rocks with ease and is as skilful as the chamois or the alpine ibex. Its most highly developed sense is that of smell. Przewalsky has written of the yak:

"The most outstanding feature of the yak is its laziness. It goes to pasture in the morning and in the evening, and spends the remainder of the day at rest, either standing or lying. It ruminates during this resting period. Apart from the movement involved in rumination, the animal remains as still as a statue."

The mating period is a time of fierce fighting and movement, and a fighting bull will sometimes lose one of its horns. The cow gives birth to a single calf after a gestation period of eight and a half to nine months. When the calf is still very small it shelters in the thick hair between its mother's legs. According to Krumbiegel, the yak can reach the age of thirty years.

The inhabitants of the high plateaux of Tibet and China keep the yak as a domestic animal and could hardly exist without it. It can exist in the most rigorous climatic conditions. There are more domestic yaks than wild ones and if the yaks ceased to exist these rough areas of mountain steppes, surrounded by high mountains, would be unpopulated. No other animal could bear such a climate, let alone give so much profit to its owner.

The caravans of yaks loaded with heavy burdens plod slowly over the peaks and through mountain passes at a height of 20,000 feet. They ford the wild torrents rushing below the glaciers and are the sole means of transportation between the mountains and the cities of the plain. The people also use them as reliable riding animals. The yak provides meat, and tents and other articles are manufactured from its skin. The cows give rich, yellow milk. Even the animal's dung is used. The Mongolian women and children gather it and dry it for fuel.

The wild yak is black and brown in colour, while the domestic animals are usually mottled, and sometimes completely white. Domestic yaks are less than half the size of the wild animals, which is the reverse of the usual as domestic animals are generally bigger than their wild relatives. The domestic yak readily interbreeds with domestic cattle, but only the females from such crosses are fertile.

The **Gaur** is a powerful animal measuring over 12 feet in length and standing 6 feet tall. Its short, thick fur is black and brown in colour, yellowish on the underside. It has white stockings. The horns grow sideways then curve inwards above the head.

The gaur is found in the inaccessible forests and grassy regions of Nepal, Assam, Burma, Indo-China, Malaya and West India. It lives in groups or small herds in mountainous areas near water or in boggy regions.

Hunters distinguish two types, the mountain gaur and the bog gaur. At present, because of hunting pressure by man, most animals live in high inaccessible mountains.

The heads of a Gaur (left) and Gayal (right)

The **Gayal** is the domesticated form of the gaur. It is found in Assam and Burma in considerable numbers. It is a heavier animal than the gaur and not so tall. Apart from its white stockings it is uniformly black and brown in colour. The horns do not turn inwards. The gayal cannot be regarded as a domestic animal in the strict sense of the word and this is explained by Kaufmann:

"All the people of Burma keep herds of semi-wild gayals which are attracted by salt licks. The gayals are tamed slowly and follow the villagers up to their huts. However, they are never completely domesticated. They always remain near the village to which they were attracted and will not follow villagers who move from the district."

Gayals are common in zoological gardens.

The **Banteng** has a small broad head. The horns grow sideways and outwards and are grooved at their roots. The tips turn upwards and inwards. The horns are from $15^1/_2$ to $19^1/_2$ inches long. The coat is grey and brown, reddening towards the rump. The most striking feature of the banteng is the white rump patch, its co-called "mirror".

The banteng is 8 feet in length and stands 5 feet tall at its head. It is found in East India, the Malay Peninsula, Java and Borneo. It has been exterminated in

Sumatra. In 1952, Appleman reported on the number of banteng as follows:

"Before the Second World War, the banteng was still a common animal in Java. Most of them now live in reservations in the east and west. Outside these regions they once roamed freely, especially along the south coast where they had been protected by hunting laws. Unfortunately, there was much poaching in the unsettled days following the war and it is difficult to give a detailed report on their present numbers.

"The tiger is generally regarded as the main enemy of the banteng. However, I once found an adult cow and then a young bull that had been torn to pieces by wild dogs, and I presume that the large packs of these dogs can be regarded as much more dangerous enemies of the banteng than the rare tigers. This is quite certainly the case in Eastern Java where the tigers have been almost exterminated. It is always much worse for the banteng if it is attacked by dogs rather than the tiger. The tiger kills quickly, whereas the dog causes great suffering to its victim. It tears the banteng alive."

The adult banteng cannot be tamed unless taken as a calf.

The ancestor of domestic cattle was the magnificent **Wild Auroch,** or **Zebu.**

Wild Auroch

Numerous drawings and reports from Europe and Asia, as well as the discovery of bones, show that the progenitor of the modern cattle was a large, powerful animal but not so stout or clumsy as the European bison. It was a much slimmer animal, quick in its movements, and with a comparatively straight back and a straight profile. Its long horns projected sideways then forward with the ends upturned. They were probably yellowish in colour with black tips. The fur was probably black and brown, or grey. The length of the tail was approximately the same as that of present-day domestic cattle. The best indication we have of the appearance of the wild zebu is from the well-known painting in Augsburg discovered by the zoologist Smith in an old curiosity shop there.

Why did man domesticate only the wild zebu and not the European bison? The answer is that in the Falz-Fein experiments it was shown that the European bison cannot be domesticated. It is presumed that the wild zebus were first domesticated in the countries of the Eastern Mediterranean where the European bison did not exist. History supports this view. The wild zebu was exterminated in historical times but traces of semi-wild animals have been found in Mesopotamia and Egypt. Until 1627, when the last cow died, the wild zebu could still be seen in the game reserves near Warsaw, in Poland.

During the thousand years period when man was raising wild zebus, many races of domestic cattle had already appeared. To this group of cattle with short foreheads belong the Bohemian red-coloured cattle and many other European mountain races, as well as the group with long foreheads, for example the Hungarian and

Scottish cattle with their long horns. Many races of cattle exist nowadays in great variety of colour and shape. Some are bred for their milk, some for their meat, and some as dual purpose animals. The small Spanish cattle used to produce bulls for bull-fighting are a primitive race. They are small, short-headed, slim and quick on their feet. In some parts of Southern France and Spain, herds of these small cattle are raised in a semi-wild state, but they would not be a commercial proposition if reared for their meat and milk.

By selective breeding man has raised many races that are highly productive in meat and milk. Breeds noted for their beef production are the Aberdeen Angus, the Shorthorn, the Hereford and the Galloway in Britain. France has produced the well-known Charollais. British beef cattle are exported all over the world, especially to America and the Argentine, but in more recent years to the Soviet Union. Many famous milk breeds have been produced, especially in Central Europe; among these are the Friesian, the Guernsey, the Jersey and the Ayrshire. The Russians have raised a highly productive race of the Kostrom breed.

When discussing milk yields great care has to be taken to distinguish between exceptional individual cows and herd averages. The three thousand gallon Friesian cow exists, but it is a rare animal. The Russians claim a yield of 3,300 gallons for a Kostrom cow, but commercial averages are much lower than this and a cow giving 1,000 gallons a year is a very good animal indeed.

Nowadays beef production is increased by mating beef bulls to dairy cows and using the cross calves for quick beef production.

Indian Zebu

The **Indian Zebu** is the ancestor of all the Indian cattle breeds, some of which are humped and some of which have no humps. The zebu of Southern Asia is the equivalent of the European domestic cow. It is resistant to hot weather and can be successfully interbred with domestic cattle. It gives birth to a single calf which is highly resistant to hot weather and a number of diseases.

Indian Buffalo

The **African Zebu** is a relative of the Indian zebu. One of the best known African races is the **Watusi** which is found in the Masai territory. The watusi has horns up to 4 feet long. Near the Chad Lake there is the **Kuri** race, the bulls of which have tremendously thick horns.

A pygmy of this group is the **Anoa** which is $6^1/_2$ feet long and stands only 3 feet tall. It is dark brown in colour except for white spots under the jaw and on the lower legs. It has strong, straight horns. Some zoologists regard the anoa as an intermediate type between the Bovidae and the antelopes.

The anoa is sometimes known as the dwarf buffalo or wood ox. It is found in the Celebes Islands and the Philippines. Very little is known of the anoa in the wild state because of its shy and retiring habits. It is found mainly in pairs in wooded areas not far from water and is much hunted for its tasty meat.

The **Indian Buffalo** is the wild form of the well-known domestic buffalo and still exists as a wild animal in India, Nepal, Assam and Borneo. The buffaloes living in the forests of Ceylon are not indigenous animals but the descendants of domesticated stock brought in from India. Within historic times this buffalo was found in Western India, Mesopotamia and North Africa, where its bones have been discovered and where it is mentioned in written records.

The Indian buffalo is a large, black and grey animal with powerful horns, flattened and crescent-shaped, which reach a span of up to 6 feet. Their spread is sometimes greater than the animal's height which is nearly six feet at the shoulder. The back is straight and there is no hump. The hair is short and rough.

In India wild buffaloes are still caught and domesticated, and in many places it is difficult to distinguish the domestic from the wild animals. The domestic buffaloes are kept in the forest some distance from the villages and when they are unattended they frequently wander off and join their wild relatives. During the mating season, wild buffalo bulls come into the villages and mate with the domestic cows, so it is no wonder that zoologists sometimes have difficulty in deciding whether buffaloes in this or that region are truly wild animals or domestic stock gone wild.

The wild buffalo lives in large herds and is seldom found far from rivers or lagoons where it can bathe and wallow. It is also attracted by great sea inlets. During warm weather it will spend the whole day in the shallow water, coming ashore only to graze. The animals feed mainly in the early morning and late evening and grass is their principal food.

Buffaloes are powerful animals and have acquired a reputation for great audacity and savagery. Hodgson has reported that an adult bull will attack and rout an elephant and there are many accounts of bulls assaulting tigers and even killing them. The buffalo and the elephant are the only wild animals that are completely unafraid of the tiger and a tiger will always avoid an encounter with either.

Domestic buffaloes are as large and powerful as their wild relatives, but are much more docile animals. They have been kept by man since time immemorial in Asia, Africa and South-west Europe. Like the wild stock, they like to bathe and wallow. They are not quite so docile as domestic cattle.

Man has raised many races of buffalo which differ from each other in size, colour and shape of horns. The buffaloes are stronger than horses and make very good draught animals, but they tend to work for only one person. Working them is difficult for they can be stubborn and it takes a strong, courageous driver to manage them. They are always liable to attack a stranger.

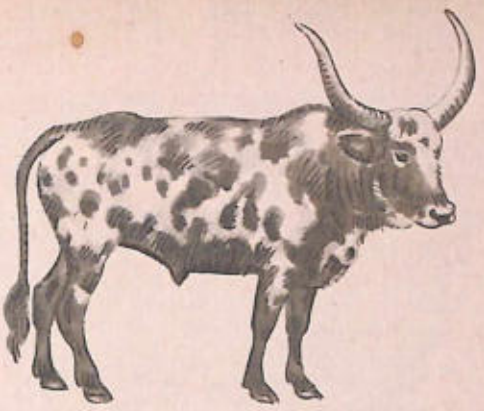
The meat of the buffalo is not particularly palatable but its hide is quite valuable. Buffalo cows give about 220 gallons of milk a year and their milk is far richer than cow's milk. Cow's milk contains 4 per cent. butter-fat: the buffalo's contains 8 per cent.

African buffaloes differ from Indian ones in the shape of their horns, and zoologists have classified them as a separate species. They are found from the Sudan to Cape Province and there are several races differing in colour, size and shape of horns. Formerly, these races were regarded as separate species but modern research has shown that there is only one species of buffalo in Africa with three geographical races.

The **African Buffalo** stands between 5 and 6 feet tall at the shoulder. The spread of its horns rarely exceeds 3 feet, but they are broad at the base so that they cover the whole front of the skull, thus forming a protective shield. The horns of the cows are shorter than those of bulls. Bulls are almost black in colour; cows are black and brown. The hide is very thin.

Bulls and cows weigh up to and over 13 hundredweights.

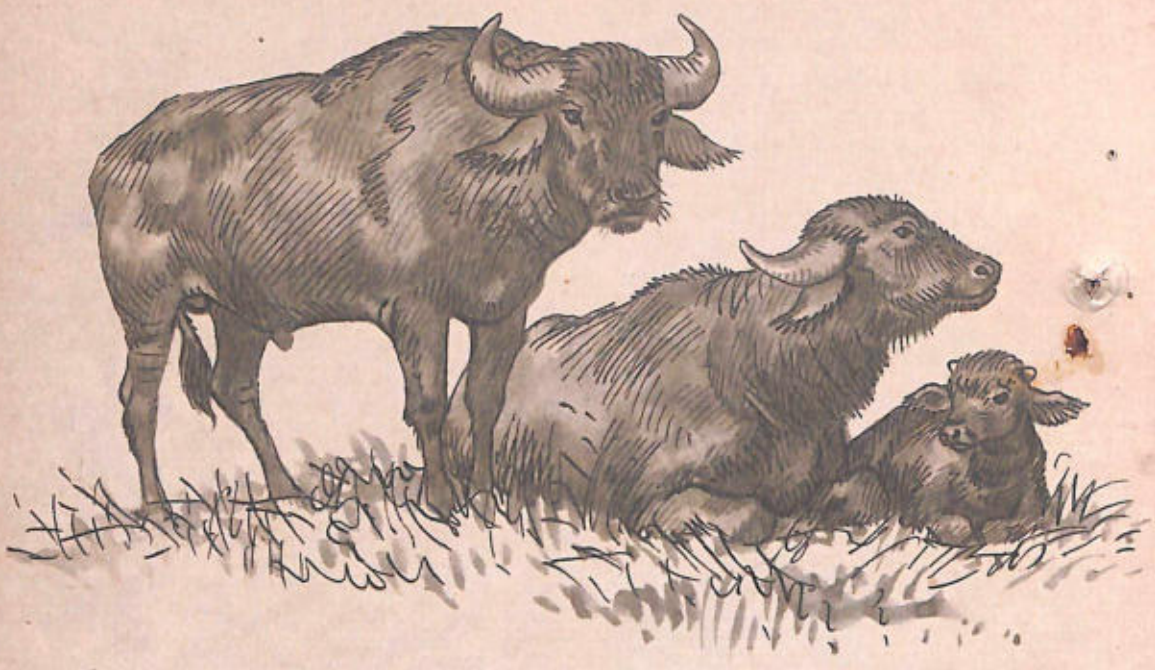
The African buffalo has been exterminated in South Africa outside the Addobusch Reservation in Cape Province



African Zebu — Watusi race

African Zebu — Kuri race

Anoa



Domesticated form of Indian Buffalo

and the Kruger National Park in the Transvaal. It is found in South-east Africa. It is found on plains and bushy pasture-lands near rivers.

At one time the African buffaloes were found in large herds, sometimes of more than one hundred animals — cows, calves and young bulls. Old bulls lived in smaller groups of two to seven animals.

Buffaloes depend little on their sight and hearing. Smell is the most highly developed sense. When the animals are resting in the shade one is always on guard, and each member of the herd takes its turn to keep watch. The animals are extremely shy and the slightest disturbance will make them herd together and run off. They are strong swimmers and take to the water as soon as danger threatens. The main wild predator is the lion, which tackles mainly straying calves or cows. A wounded African buffalo can be a very dangerous animal as some hunters know to their cost, but in fact hunters are seldom attacked by a wounded animal. A hunter pursuing a wounded animal is more liable to attack because the animal will run away, then hide to await his approach.

Machulka, discussing the African buffalo, says:

"Wounds caused by African buffalo, and those caused by a lion, are treated differently. The African buffalo can cause more serious wounds than the lion; it gores its rival with its horns and throws it up in the air, repeating this several times. In the end it tramples its victim to death. If the victim escapes with wounds on the legs or hands, they do heal in the end. I knew natives who, in spite of being seriously wounded, were healed by primitive treatment. The lion, on the other hand, bites or wounds with its claws. On

its teeth and claws there are always the remains of decaying meat and therefore such wounds end in blood poisoning and are usually fatal."

The African buffalo gives birth to a single calf, usually between December and February. The gestation period is eleven months.

The **Red African Buffalo,** or **Dwarf Forest Buffalo,** stands about 3 feet tall and weighs between 450 and 650 pounds. It has thinner horns which turn upward and backwards.

This buffalo is found in West Africa between Gambia and the Southern Congo.

The red African buffalo never forms big herds and when escaping from danger travels in Indian file, unlike the previous species which crashes through the reeds and other cover *en masse*. Instead of crashing through the cover, the small red buffalo goes under it. In this respect, its behaviour is like that of jungle antelopes. Its small, wedge-shaped body, lower in front than behind, and its back-curving horns are adapted to such behaviour. If attacked by man, the red African buffalo will defend itself just as fiercely as the previous species.

The next group in the superfamily of horned animals is made up of goats, sheep and antelopes. The group includes large and small species, most of them found in Africa and in Central and Southern Asia. Zoologists found great difficulty in classifying the species in this group.

The spiral-horned antelopes are mostly strong animals which differ from the true antelopes by living mainly in forests and jungles. They often have stripes on their bodies. In some families only the males have horns, while in others both sexes are horned. The spiral-horned antelopes are found in Africa, south of the Sahara, and in Asia.

The **Bush-buck** is an African spiral-horned species in which only the males have horns. These horns are from 8 to 12 inches in length and have one spiral. Males are about $4^1/_2$ feet in length and stand nearly 3 feet tall at the shoulder. The colouring is very striking. The head is yellowish-grey; the front of the body and the back are grey; the sides of the body and the rump are rusty-red. There is a white band across the chest, white spots on the body, and white on the legs and the base of the ears. The back has several white stripes and a mane of long hair.

There are twenty-one geographical races of this species found in the jungles of Africa south of the Sahara. To some

Bush-buck

Marsh-buck

tribes in Liberia it is a totem animal; that is to say, it is considered a blood relative which must not be harmed. As a result of this, the bush-buck in such regions is trusting and tame and can often be seen in the villages roaming around the huts.

Elsewhere, the bush-buck is a secretive animal. It lives mostly in pairs and comes out in the evening to feed and drink. It is strictly nocturnal. The main food is browse and tender grass shoots.

Young bush-bucks are born in September and October.

The leopard is the main enemy of the bush-buck, preying upon females and young, but an adult male will sometimes put a leopard to flight.

A close relative of the bush-buck is the **Marsh-buck,** or **Sitatunga,** which has spreading hoofs adapted for walking on soft, boggy ground. This species is found in the boggy areas of jungles, frequently in regions of inaccessible papyrus growth. It is found south of the Sudan from the Congo to South-West Africa.

The marsh-buck is an important carrier of sleeping sickness, which is transmitted by the tsetse fly.

Unlike the bush-buck, the adult marsh-buck is uniformly coloured. The young, however, have stripes.

The **Giant Kudu** is perhaps the best known antelope. It is certainly one of the biggest, standing $5^1/_2$ feet tall at the shoulder and weighing about 650 pounds. It has the bearing of a large red deer. Its head, which it carries high, is adorned by magnificent spiral horns up to five feet in length. The cows are smaller and hornless.

The kudu is uniformly reddish-brown in colour and has from four to nine white vertical stripes on its body. The bull has a strip of dark mane on his neck and back, and long hair on his throat.

Giant kudus live in small herds made up of cows and immature bulls. Adult bulls join these herds only in the mating season. This species like bushy or tree-covered plains and broken hilly country, and is found from Cape Province to Kenya and the Sudan. Although it is sometimes found in thick cover, it cannot normally be regarded as a forest animal. It never strays far from water. During the day it lies up in cover, emerging in the cool of the evening to feed.

The remarkable horns of the kudu bull have always been regarded as a valuable trophy. After the first heads were brought to Europe by European hunters, the horns were in great demand.

The young kudus are born in mid-summer, after a gestation period of seven months. The bellowing of the kudu bulls is the loudest uttered by any species of antelope.

The **Lesser Kudu** is now found only

XIII 1. *African Buffalo* 2. *Banteng* 3. *Yak* 4. *Zebu* 5. *American Bison* 6. *European Bison*

in a corner of North-east Africa. Originally, it was distributed through Somalia, Kenya and Eastern Ethiopia. It is a much smaller animal than the giant kudu, standing about 3 feet tall. It is similar in appearance but more colourfully marked. This species is found in woods, forests and thick jungle on the banks of rivers.

The **Bongo** is an antelope of the African jungle and is found in West, Central and East Africa.

In this species both sexes are horned. The horns are lyre-shaped, strong and somewhat flattened, with white or yellowish tips. Their length does not exceed 2 feet. The bongo stands between $3^1/_2$ and 4 feet in total height. Its tail resembles that of the bison. The bongo is one of the most beautiful antelopes, being cinnamon red in colour with ten to fifteen stripes on its back. There are white marks on the chest and forehead, and the lower limbs are black and white. Such striping indicates that the bongo is a forest animal.

Few Europeans can boast of having seen the bongo because it spends most of its time in impenetrable thickets and seldom appears in open spaces. The bongo visits coffee plantation during the night and does much damage by eating the pulp from the coffee beans.

Bongos were quite common in the Congo at the end of the last century, but even before the First World War they were becoming rare due to excessive hunting. It is now nowhere numerous.

The **Eland** is the biggest of all antelopes, standing almost six feet tall at the shoulder and weighing up to 17 hundredweights. It resembles a heavy-weight deer rather than an antelope.

Eight races of eland have been described, all of them living south of the Sahara in South and East Africa. The biggest race, formerly regarded as a separate species, was known as Derby's antelope and weighed up to 19 hundredweights.

Lesser Kudu

Elands are generally light-brown in colour but have a black dorsal line and a black tail tuft. They have a prominent dewlap with a black tip and a distinct hump. Most of them have several white vertical stripes on the body, mainly behind the shoulder. In old males, the mane on the neck can be very striking.

Both sexes have horns which measure up to 3 feet in length. Females have thinner horns than males. The horns are only slightly spiralled.

Elands live in small herds of twenty to thirty animals, mainly in grassland with thorn bush cover, or on the forest fringe. Mayer saw a herd at 15,000 feet on the

plateau of Kilimanjaro. South African elands often flock together to form bigger herds than those in the north. The animals feed mainly on browse, although they sometimes eat grass. They can exist for long periods without water, but drink when there is water available. They make periodic migrations, when they sometimes cover great distances.

Attempts have been made from time to time to domesticate the eland because it tames easily. Besides being eaten it has been used as a draught animal.

The gestation period in this species is 255 days, the calves being born in October and November.

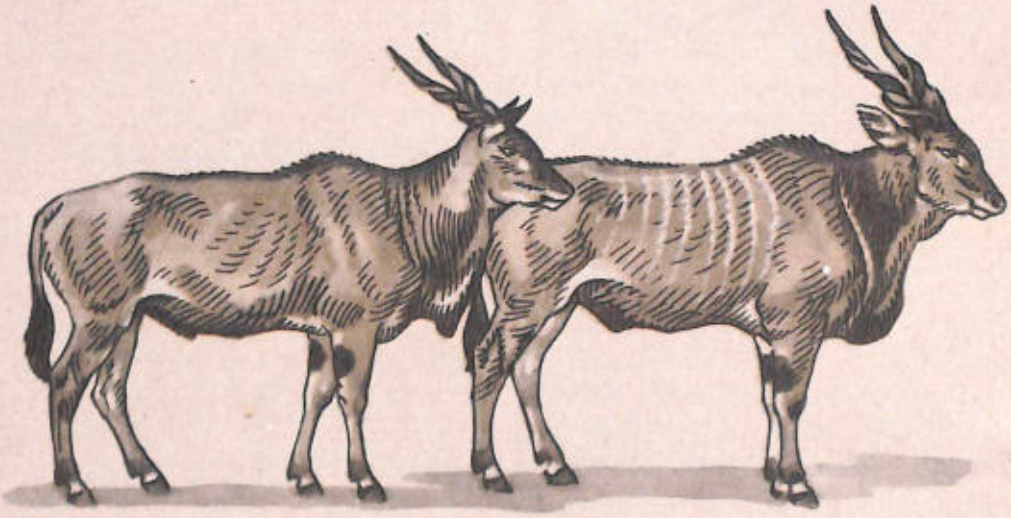
In the Sudan, hunters receive a permit to shoot one bull. After he has killed one bull no further permit is issued to that hunter.

The **Nilgai** is commonly kept in zoos and is still plentiful as a wild animal in Western India and Eastern Bengal. It is the biggest of the Indian antelopes and stands about 4 feet tall at the shoulder. Only the males have horns, which are about 10 inches in length. The nilgai is not therefore much sought after as a trophy animal, although it was once hunted by the Moguls and is still hunted by the local people.

The overall body colour of this species is blue and grey and in fact the name nilgai means blue bull. The bull is indeed blue but the cow is a brownish colour. Both sexes have a white throat patch and a neck mane. In addition to this, the male has a short black tuft below the white throat patch. Above the hoofs there are two white rings.

The nilgai is a forest animal and lives in small herds in thin forest and bushy jungle near rivers. It spends the day resting in the forest shade and comes out in the evening to graze in forest glades and meadows. The nilgai is elegant when it runs and resembles the red deer, despite its hump.

During the mating period the males fight fiercely with each other. The gestation period is eight months and the



Eland (left) and Giant Eland (right)

female gives birth to one young. In India, the young are born in the winter months. In Europe, however, the nilgai adapt themselves to the changed conditions and the young are born in the summer months.

The **Four-horned Antelope** is a small Indian species, standing between $23^1/_2$ and $25^1/_2$ inches tall and measuring about 3 feet in length. Some animals grow four horns but these are not a regular feature. The rear horns are bent forward, have rings at their roots, and measure between 4 and $4^1/_2$ inches in length. The front horns correspond to the odd horns of the giraffes and are between $1^1/_2$ and 2 inches long. The females are hornless.

The general body colour is brown above and white on the underside.

This species likes the same kind of habitat as the nilgai and is found from Kathiawar and the central provinces to the eastern part of the Ghat mountains. It is frequently to be seen in the hilly regions of forest and scrub. Not much is known about its way of life in the wild and it is seldom seen in captivity. Zoo keepers do not like it because it remains wild and is always liable to attack other animals as well as keepers.

Four-horned Antelope

The gestation period is seven and a half months and the females give birth to one or two young.

Duikers are small antelopes with a slim elongated head, a tuft of hair on the nape, and straight or moderately curved horns. Between the nose and the eyes are two glands. There is a bald patch round the eyes. The females have four teats. Sixteen species of duiker have been described, all of them from Africa.

The **Yellow-backed Duiker** is the biggest species and is found in West Africa from Sierra Leone to Angola and Northern Rhodesia. The body is reddish in colour. The cheeks are grey and the tuft of hair on the nape is rusty-red. This species lives in the thick undergrowth of the jungle, singly or in pairs, and feeds on herbs, seeds and fruits. It figures largely in the fairy tales of the Belgian Congo.

The **Grey Duiker** is found in East Africa. It is about 3 feet in length and stands

The heads of Yellow-backed Duiker and Grey Duiker

19 inches tall at the shoulder. It has straight horns, spiral-grooved, measuring between $2^3/_4$ and $4^1/_2$ inches in length. Its colour is very variable.

The grey duiker inhabits the thickest undergrowth in the forest, into which it dives at the first hint of danger. There it hides, ducking out of sight and crawling from one place to another until the danger is past.

In this species the face glands are well developed and show as a dark slit beneath the eyes. The duiker marks its range by rubbing its face against branches and twigs as the roebuck rubs its forehead. Like the roebuck it has the habit of standing on its hind legs when browsing on twigs or berries. Occasionally, the animal varies its diet with insects and snails and it is said to eat even frogs.

To this subfamily belong the medium sized and larger antelopes of South Africa. They live in gallery forests, alongside rivers, in bogs and other humid regions, and all of them are dependent on water. Only the males have horns which are spiralled and grooved. The muzzle is bare and the false claws well developed. All the species in this subfamily resemble each other and differ mainly in size.

The **Bohor Reed-buck** is found in West, Central and South Africa. It is brilliant brown in colour. It lives in pairs or family parties beside bogs and rivers, among bushes and reeds. Drayson describes its habits as follows:

Bohor Reed-buck

"The Bohor reed-buck is usually found in the bog grass. Only when it is approached will it run away, but it soon stops to look back at its pursuer. All the time it utters strange sounds which are its undoing because the hunters can keep in touch with it by listening. The reed-buck is very fond of young, ripening corn and as a result is not popular among the farmers."

The **Water-buck** is the size of the red deer, being about 6 feet in length and standing 4 feet tall at the shoulder. The coat of old males is grey or grey and brown, while that of females and young animals is mostly rust-red in colour. There is a white throat patch. There is a white stripe like an arch passing over the back to the root of the tail. The fur is thick and curly. Only the males have horns which are back-curving and measure up to 30 inches in length.

The water-buck is found in Southern Ethiopia and in East, South and South-west Africa. According to Berger, it does

not need to live near water and in fact is sometimes found living in the middle of dry plains. Animals living far from water try to escape by running, while those living close to water will plunge into it when pursued by an enemy.

The **Defassa Water-buck** has no white stripe on its rump. It has pointed ears, light-coloured cheeks and a white throat. The coat of the males is grey and brown, that of the females and young rusty-brown.

This species is found in Angola and East Africa, and thirteen races have been described.

The Defassa water-buck stands 50 inches tall and the horns of old males reach a length of up to 36 inches. The species is still quite common and not difficult to approach. It is hunted for its tasty meat.

Although it is a true reed-buck, this species does not appear to like water. Concerning this, Dr. Baum reports:

"I once witnessed an interesting hunt in the Southern Sudan. The natives, armed with spears, drove a Defassa water-buck to the bank of the river, hemming it in such a way that its only way of escape was by the river. The antelope entered the thick reeds and approached the water, but it was clearly at a loss what to do next. Perhaps it had an instinctive fear of crocodiles. Only when hard-pressed by the hunters did it plunge into the river. It swam, drifting with the current, but climbed out on to the bank again a few yards downstream. The Negroes chased it again and soon I saw the head of the antelope above the level of the river. I do not know the end of this hunt, but one thing is sure — the Defassa water-buck's fear of water was second only to its fear of the hunters. It could have

Water-buck

Defassa Water-buck

swum across the river to safety, for the hunters had no boat, but it did not do so."

In the following group both males and females have horns which are long, slim and ringed, and can be straight or spiralled. Some species have tails of medium length, while others have long, shaggy tails reaching to the heel joint. Unlike the reedbucks, the members of this subfamily have bare muzzles. There are scent glands between the toes on fore and hind feet.

The **Roan Antelope,** found in Africa, Arabia and Iran, somewhat resembles a horse. It is shaped like a horse and has a strong mane on its nape. It is a handsome animal, rusty-black and grey, or roan. Its cheeks are almost black. The mouth is white and there are white spots in front of the eyes. The horns of the males bend backward and their tips are set wide apart. They are ringed throughout their length and egg-shaped in section. The horns of males measure up to 30 inches in length; those of females are about 4 inches shorter. An adult roan antelope stands 6 feet tall at the shoulder and measures about 5 feet in length. The tail is about 27 inches long.

Roan Antelope

Roan antelopes are found in groups and small herds in most of Africa south of the Sahara, on grassy, tree-covered plains, in lowlands and mountains. They avoid areas of continuous forest.

This is the fiercest of all the antelopes and, during the mating period, fighting between males is sometimes a life or death affair. Few males survive with undamaged horns. It is said that the roan antelope uses its horns for scraping out termite nests in order to reach the soil which contains salt. Like all ruminants, antelopes are fond of salt.

The **Sable Antelope** is slightly smaller than the roan. A fully-grown bull stands about $4^1/_2$ feet tall at the shoulder and weighs about $4^1/_2$ hundredweights. Both sexes have large horns, sweeping up and backwards, which measure 4 feet over the curve. The horns of the females are shorter than those of the males.

Old bulls become jet black in colour, but females and younger males are satin-skinned and browner.

Sable antelopes are found in East Africa, from Kenya southwards, and westwards to Angola and the Southern Congo. They live on the plains in herds of ten to fifty animals. Each herd is usually composed of females and young animals led by an adult bull. The animals are grazers and are active early and late in the day. They associate with zebras and kudus. Hunting dogs kill young animals, but the lion is the only predator on adults.

Young sable antelopes are born between November and January, after a gestation period of 270 days.

The **Arabian Oryx** is found in Arabia and Iraq and was once a common species, whose range extended into the Libyan

desert in North Africa. Evidence in support of this is provided by Egyptian and Nubian tombstones on which oryxes are represented as domestic animals with ropes round their necks. The Ancient Egyptians depicted other antelope species, but the oryx was the one most frequently drawn. The Egyptians kept many oryxes. The tombstone of the arch-priest Sabonna in Memphis, dating from the beginning of the Fifth dynasty, records that he owned 5,578 head of cattle, 1,308 oryxes, 1,244 addaxes and 1,135 gazelles. Antelopes were kept by the Egyptians mainly for their meat.

Now the Arabian oryx is threatened with extinction and may soon be exterminated in its native land. Specimens have, however, been moved to Arizona in North America where they have settled down and bred. This attempt to save the oryx from extinction was financed by the World Wildlife Fund.

The **Gemsbok,** or **Cape Oryx,** is the best known species. It measures 6 feet in length plus a tail of $15^1/_2$ inches and stands 4 feet tall at the shoulder. It has short, thick hair which becomes a mane round the neck. The neck, back and flanks are red and grey; the head, ears and hind part of the rump as well as the chest, abdomen and legs, are white. There is a black flank band, and black bands on the upper parts of the forelegs.

Males and females are horned. The horns are brilliant black, straight or moderately bent, pointed at the tips and ringed. Horn length varies over the beast's range and increases southwards.

The gemsbok lives in dry plains from Rhodesia and Angola to Cape Province. It has been completely exterminated in heavily populated areas of Cape Province and some other regions. It lives in large herds and feeds on a variety of grasses as well as leaves and roots. It obtains most of its water from roots and tubers and seldom needs to drink.

The heads of Arabian Oryx, Gemsbok and Scimitar-horned Oryx

The **Beisa** is a race of the gemsbok and is found in the northern part of the species' range. In the Beisa, the flank line is narrow and the upper parts of the legs are white instead of black.

Gemsbok

The **Scimitar-horned Oryx** lives in the heart of North Africa, in the Sahara. It has long horns which are bent backwards. The coat is yellow and white in colour. This antelope is also classified as a race of the gemsbok.

The **Addax** is a strong, low-set, clumsy antelope with ringed horns slightly twisted in the shape of a lyre. In adult animals, the horns form two spirals. The basic colour of the coat is yellow and white; the head is brown. There is a white blaze between the eyes and a white spot behind the ears and on the upper lip. The addax stands between 3 and 4 feet in overall height.

Formerly, addaxes were common along the west coast of North Africa, in the Tunisian and Algerian Sahara up to Kordofan and southwards in the direction of Senegal and the Chad Lake. Now it is becoming rarer. The Arabs regard the addax as a noble animal of the chase and hunt it with specially trained dogs. Despite its speed and endurance, the addax rarely escapes. Nowadays, the practice of hunting them in motor cars instead of on horseback has speeded up their destruction. By 1900, the animals had been exterminated in Egypt. Although hunting is prohibited in many African states, it is still carried on illegally. Motor cars can easily run the addaxes to death because the ground is easy to cover, even off the roads. Hunting regulations are, therefore, of little value.

Hartebeests are large antelopes standing about 4 feet tall at the shoulder and weighing 400 pounds. They have slim, elongated, giraffe-like faces, slim limbs, and backs sloping steeply from rump to tail. Males and females are horned. The horns are upright and lyre-shaped. There are glands below the eyes and a tassel at the end of the tail. Females have only one pair of teats. Hartebeests are found in the semi-deserts and thinly covered plains of Africa and are able to exist with very little water.

At one time several species of hartebeest were described, but these are now generally regarded as races of a single species. Various races are distinguished mainly by the shape of their horns. **Coke's Hartebeest** is found in the East African plains from Southern Kenya to Tanganyika. The **Cape Hartebeest,** once a common

XIV 1. *Beisa* 2. *Nilgai* 3. *Sable Antelope* 4. *White-tailed Gnu* 5. *Blesbok* 6. *Brindled Gnu* 7. *Cape Hartebeest* 8. *Addax*

species in South Africa south of the River Limpopo, is now almost extinct. Several small herds exist in South African reservations. **Lichtenstein's Hartebeest** is the one most frequently seen in East Africa.

Schweinfurt has written of the **South African Hartebeest** as follows:

"In unpopulated regions we can see most frequently groups of five or ten animals. In cultivated regions the animals prefer light, bushy forest near the river. At noon they like resting near termite nests or under trees. Because they are capable of standing motionless against a background which matches their own colour, they can escape attention for a long time."

Johnston writes that he has frequently mistaken hartebeests for the reddish nests of termites.

Usually a herd is led by an old bull, but sometimes by a female as well. The animals post sentinels and a common lookout station is the top of an ant-hill from which the watcher obtains a better view of the country. Hartebeests are often found in the company of gnus and zebras.

The **Blesbok** has been almost exterminated and now exists only in small groups in protected areas. Its close relative, the **Bontebok,** was once thought to be the rarest antelope still existing, but it has been saved by careful protection and its survival assured. The blesbok and the bontebok are regarded as races of a single species.

Gnus are remarkable animals, antelopes with something of the horse and something of the bison in their appearance. They have a stout body, a large square head resembling that of the bison, and their back slopes towards the rump.

Lichtenstein's Hartebeest and South African Hartebeest

Males and females have wide flattened horns, curving inwards at the tips. The shoulder height is over 4 feet and the weight up to 500 pounds. Adult males have a pronounced neck mane. The rest of the body hair is short and tight. Females have two teats.

Blesbok and Bontebok

The **White-tailed Gnu** is 9 feet in length and stands, $4^1/_2$ feet tall at the shoulder. Its general colour is grey and brown. The tail, which almost reaches the ground, is white except at its root. The horns twist down and out then up and backwards. In the case of old males, the base of the horns broadens so that they cover part of the skull. Females have smaller and thinner horns.

The white-tailed gnu has suffered the same fate as so many other South African mammals. The settlers who came in great numbers to this region, especially the Boers, had little use for the country's rich heritage of wildlife and destroyed much of it. They regarded all large animals as harmful and the big ungulates as destroyers of cultivation. Even in uncultivated regions, where many of these animals could survive, they are still killed at random. The white-tailed gnu is no longer to be found in a free state although in the early nineteenth century the herds consisted of thousands of animals. Nowadays, it is to be seen only in small groups in South African reserves. A few animals are kept as rare specimens in zoological gardens.

The **Brindled Gnu** is bigger than the previous species, being about $9^1/_2$ feet in length and standing 5 feet tall. The mane on its neck and throat is longer than in the white-tailed gnu. It is blue and grey or ash-grey in colour, faintly striped on the flanks. The face is black and brown, the nape, neck, mane and lower jaw are black. The horns grow horizontally outwards, then turn up and inwards at the tips. Five geographical races of this species have been described.

One of these is the **White-bearded Wildebeest** which is found in Kenya near Lake Tanganyika. It can still be seen in considerable numbers on the East African plains. Dr. Ullrich, who visited Africa a few years ago, encountered a large herd which he wrote about as follows:

"We were travelling alongside a big herd of gnus which were standing not far from us. The animals were moving slowly in the direction of Lengai and could be identified with certainty only by means of field-glasses. The quivering of the air made it almost impossible to recognise the outlines of their bodies. It was a large herd consisting of perhaps one thousand or more animals. They were scattered all over the grassy plain.

"We moved in more closely to the herd and observed the animals through field-glasses. Most of them were grazing on the dry, dusty grass, which is very poor nourishment. I kept thinking of the antelopes in zoological gardens which are fed on the best hay all the year round. What a difference from the food of these wild creatures. When the rains come the yellow plain becomes richly green and the table of the herbivores is laid, but this does not last long. The sun soon dries out the last drop of water and the green garden becomes a dry stubble field.

"In the middle of the grazing animals stand some smaller groups. The gnus are resting. They stand almost motionless, with their tails lashing their flanks. From time to time they blink and their long eyelashes cover their eyes. We can see that there are females with calves in the herd. The young are very impatient and keep leaping into the air. From time to time, we see an animal leaving the adjoining herd and running quickly as though pursued by hyena dogs. It kicks with its hind feet, runs in a wide circle

and then returns to the herd. These movement exercises are not confined to young animals.

"When two members of different herds meet they fall down on their knees in a flash and meet head to head with a crash of horns, but this cannot be regarded as a serious fight. On the contrary, we have the impression that they take great care not to hurt each other.

"In the herd there are many young animals to be seen. I estimate that they are about three or four months old. This would correspond with the age of the young animals in the National Park at Nairobi. In this reservation, females give birth to their young in March. The horns of the young are not yet twisted to the sides but stand erect. The fur of the young animals is golden-brown, quite unlike the silvery-grey of the adults."

Brindled gnus are not yet threatened with extinction. In certain East African territories, and on many reservations, they are strictly protected. Let us hope that this state of affairs will continue.

To the next group belongs the smallest ruminant — the **Royal Antelope** of West Africa, which is found in thick undergrowth on the jungle fringe. This species stands about ten or twelve inches tall at the shoulder. The horns of the male are short spikes about an inch long. Not much is known about the habits of this antelope in the wild except that it is nocturnal and makes a habit of raiding coffee plantations. It is found in Liberia, the Ivory Coast and Ghana.

To the same group belongs the **Oribi** which is found in East and South Africa. Its fur is rusty or yellowish-brown in colour. It is found usually in pairs or in small groups on grassy plains. When startled, it rushes off through the grass, leaping high into the air from time to time to look behind.

Oribi

The **Klipspringer** is a chamois-like antelope found in the mountains of East and South Africa. Like all hoofed mountain animals it has a short body, strong legs and almost vertical hoofs which touch the ground only with their front edge. The klipspringer is a handsome animal with a short head, large dark eyes, long rounded ears and short upright horns. The females have no horns. The body colour is olive-yellow, black-spotted on the upper parts. The underside is paler.

The klipspringer does not live high in the mountains and is found mostly in rocky regions about the 2,000 feet contour. In Ethiopia, however, it can be found up to a height of 8,000 feet. African travellers describe it as a quick-moving, sure-footed animal, completely at home on rocky terrain.

The Dik-diks stand between $12^1/_2$ and $15^1/_2$ inches tall at the shoulder. Their muzzle is bent downwards and is covered

Klipspringer

with short hair right to the nostrils. There are well-developed glands below the eyes. The tail is short. The horns are short, straight, and grooved near the base. Only the males have horns. The females have only one pair of teats.

The **Damara Dik-dik** has a muzzle not unlike the trunk of the tapir. The fur is rusty-brown in colour. This species is found in Somaliland, near Lake Tanganyika, in Angola and Damara. It spends most of its time hiding in bushes or among rocks.

Salt's Dik-dik is 2 feet in length and stands only $13^1/_2$ inches tall at the shoulder. It is found in a small area of Kassala in the Sudan and in Northern Ethiopia and Eritrea. Its coat is rust coloured on the upper side and white on the underside.

This antelope is common in Ethiopia, from the coast up to a height of 6,500 feet above sea level. It lives in pairs, usually among thick bushes, and can be found only with difficulty. It has well developed senses, especially the sense of hearing, and is alerted while a human being is still a long distance away. It leaps to attention and listens to the slightest sound. Having done this it then has to look for what has made the sound. A male will move to an open space and stand as still as a statue observing the approaching enemy. The female follows him at a short distance.

If this antelope is taken young it settles down well in captivity and becomes affectionate and tame. It will eat from the hand and allow itself to be nursed in its keeper's arms. Some travellers have brought young animals from Africa and kept them in their flats. However, the secretion of the eye glands smells strongly of musk, which many people find unpleasant.

The species in this next group are typical of desert and semi-desert. They are medium sized antelopes, standing between 2 and 3 feet in height. The eyes are large and the muzzle covered with hair. Horns vary in shape and length from species to species. They are found in Africa, Western and Central Asia and some kinds even in South-eastern Europe.

The **Blackbuck** is 4 feet long and stands nearly 3 feet tall at the shoulder and is therefore smaller than the fallow deer. It has a medium sized tail which ends in a tuft. Males are dark-brown and grey on the head, flanks and outer sides of the

limbs, and white on the face. Females are much lighter in colour. The horns of the males are from $15^1/_2$ to $20^1/_2$ inches long, exceptionally up to 29 inches. As a rule they are twisted three times. Females rarely grow horns.

The blackbuck is a fiery, aggressive animal and retains these characteristics in captivity. In the mating period, they are at their most aggressive and at this time secrete a strong-smelling substance from the glands under their eyes.

Blackbucks are found on open plateaux in Western India with the exception of the areas close to the Himalaya mountains. During periods of drought or hunger, the animals form into big herds. Observers have reported herds of 8,000 to 10,000 animals. Groups of forty to sixty are, however, more usual.

The animals are very fertile, mature quickly and give birth to a single young. Blackbuck hunting is a favourite sport in India. Europeans hunt with a gun. The blackbuck are so fast that neither a horse nor hound could catch them, so the Indians hunt them either with trained eagles or cheetahs. Despite intensive hunting by man, the numbers of blackbuck do not appear to be diminishing.

The **Impala** has lyre-shaped ring horns up to $19^1/_2$ inches in length. The females are hornless. On the hind legs above the hoofs there is a tuft of black hair. The impala is a big antelope standing about 3 feet tall and measuring 7 feet from nose to tip of tail. The general colour is light yellowish or rusty-brown, much paler on the underside.

Herds of impalas can be seen on the grassy, bushy, and tree covered plains of Kenya, the Transvaal, Bechuanaland, Western South Africa and even in Southern Angola. Herds number from ten to many hundreds, each of them led by an old bull. The animals are never found far from water because they drink freely. Young bulls are said to act as sentinels. When startled, the herd bounds away at speed, leaping ten feet into the air and covering a distance of thirty feet at each jump. Kirby states that one impala cleared a distance of 40 feet in one bound. The impala begins its high jumping from the moment of take-off and this habit may have something to do with making an attack by predators more difficult.

The **Springbok** is the national emblem of South Africa. It differs from all other antelopes in having a skin fold covered with long hairs situated along its rump and back. When the animal is at rest this fold is closed. However, when it is walking quickly or jumping, the fold opens and the hairs, which are from 8 to 10 inches in length, stand erect like a white flag. Thus the whole appearance of the animal is changed.

The springbok measures 5 feet in length and stands 3 feet tall at the shoulder. The back and flanks are cinnamon-brown in colour. The undersides and the rump patch are white. The face is white with a dark stripe joining the mouth and the eye. There is a black band along the flanks between the upper brown and the lower white hair. Both sexes have black, lyre-shaped horns about a foot in length.

At the end of the last century, springboks could still be seen in great numbers in South Africa. At times of drought, they formed into big herds and migrated to regions where food was more plentiful and water available. During the great migration of 1896, the enormous herd covered an area of 15 by 125 miles. When

Springbok

they moved on they left behind them a grazed desert. The government issued fire-arms to the farmers so that they might protect their crops. Gordon Cumming gives us an interesting description of this event.

"Every traveller who has seen such a great number of springboks is afraid that nobody will believe it, so fantastic is the sight of these migrating animals. It is quite right to compare the herds of springboks with clouds of grasshoppers."

It once seemed that the springbok would become extinct, but this has not happened, although it very nearly did. To-day the species is found in several reservations. Apart from this, owners of large estates kept some in a semi-wild state in private game reserves and supplied the town markets with meat. Thus, they are doing what the Ancient Egyptians did with other types of antelope.

In the north, near the Kalahari desert, springboks can still be seen living wild in great numbers.

The **Gerenuk,** or **Giraffe-antelope,** is a slim bodied species with long, slender limbs and a long, thin neck. The head is small, the skull thick-boned and greatly extended behind. Only the bucks have horns, which are about 15 inches long, curve backward then forward at the tips, forming a kind of lyre shape. Both sexes are chestnut-brown in colour, paler on the flanks, and white on the underside.

This species is found on the bushy plains of Somalia, Uganda, Kenya and Tanganyika. It lives in small family groups or in pairs and is often found far from water.

Like the giraffe, it feeds on the leaves of trees and bushes, rearing on its hind legs and resting its forefeet against the trunks of trees to reach the foliage. In this it is also helped by its long neck. Some observers claim that gerenuks obtain most of their water by drinking each other's urine and that males will drink only the urine of females.

Gazelles form a sub-group of antelopes. They are slim, medium-sized animals with ringed, lyre-shaped horns. They live on the deserts and arid plains of North and East Africa, West India and Central Asia, and resemble each other in their general appearance and way of life.

Grant's Gazelle stands about 3 feet tall at the shoulder and has horns about 30 inches in length. The colour of the upper parts is light rust. The rump patch and abdomen are white and there is a dark, or even black, line of demarcation between the zones. The face is the typical gazelle "drawing" in black, white and brown. There is usually a black spot above the muzzle.

Thomson's Gazelle is sandy-red above and white on the abdomen with a wide, dark band between the colour zones. This species stands about 26 inches tall at the shoulder. The rump patch is pale and the tail jet-black. When excited, the animal shakes its tail vigorously.

This species is found in the Southern Sudan and in Tanganyika and is gregarious. Adult males run with a herd of females. Old males become solitary and occupy small territories of their own. Thomson's gazelles lie up during most of the day, feeding and drinking mainly in the morning and evening.

The **Dorcas Gazelle** stands only 2 feet in overall height. A number of geographical races of this species inhabit the whole territory of North Africa from the Atlantic Ocean to the Red Sea. It is also found in Ethiopia and the Chad Lake. In Asia it is found in Palestine, Syria and Arabia.

The **Persian Gazelle** is about 3 feet long and stands between 26 and 27 1/2 inches in overall height. The tail is about 10 inches in length. Weight ranges from 55 to 66 pounds, so it is about the size and weight of the European roe deer. Coat colour varies between rust and sandy-yellow. The tail is much darker. Only the males have horns, but in exceptional

Thomson's Gazelle

cases, females may produce small ones.

This is an Asiatic gazelle and according to Ellermann is found in the regions of the Caucasus, Turkestan and the eastern zone of the Balkhash Lake, in Mongolia, North-west China, Northern Tibet, Persia, and the valley of the Euphrates, Afghan-

Dorcas Gazelle

Persian Gazelle

istan and Baluchistan. Over its range, six geographical races of the Persian gazelle are to be found.

V. V. Petrov gives this account of the Persian gazelle:

"This is a typical gazelle, inhabiting waste and semi wastelands, and rocky and sandy cover with thin vegetation. Sometimes it moves on to the forest-covered slopes of mountains and even higher, but it does not live high and is not a mountain species. During the year, Persian gazelles make considerable migrations in search of food, especially during periods of drought. It moves to lower ground in winter and to higher ground in summer. In the Soviet Union, the mating period begins in November or December and lasts about one month. In the second half of April, or at the beginning of May, the female gives birth to two kids. Single births are exceptional. The kids are helpless at birth and are not able to walk until the third or fourth day. In late summer, females and young form large herds, and in autumn herds numbering up to one thousand animals can be seen."

In the Soviet Union, hunting of this gazelle is strictly prohibited. Elsewhere on its range it is killed for food because its meat is of high quality.

The **Mongolian Gazelle,** or **Zeren,** generally resembles the Persian gazelle but is a bigger animal and lighter in colour, with a short tail. The horns tend backward and are usually short. Some females are hornless, This species measures 5 feet in length and stands between 2 and $2^1/_2$ feet in overall height. It weighs about 85 pounds. Coat colour changes with the season, the winter fur being light brown and the summer fur rusty-brown. The Mongolian gazelle is found south-east of the Baikal Lake, in the Chui steppes, in the regions south-east of Altai, and in Mongolia and China. In Mongolia, it can be seen at heights of 2,000 to 6,000 feet above sea level.

Formerly, this species was notable for its considerable migrations, which were described by Pallas in 1776 and Radde in 1862. According to Radde, one of the main migration routes was near the Agrun River. Apparently, such great and regular migrations no longer take place, but in Mongolia there is a southward movement in spring and a movement northwards in autumn. These movements are influenced by the depth of snow and the condition of the pastures. Unlike the Persian gazelle, the Mongolian species is highly dependent on water. It visits watering places regularly — every day in summer and once in two or three days during other seasons. The Mongolian gazelle is an uncommon species in the territory of the Soviet Union, where it is protected by law throughout the year.

The **Saiga Antelope** is almost certainly

XV 1. *Damara Dik-dik* 2. *Saiga Antelope* 3. *Blackbuck* 4. *Mongolian Gazelle* 5. *Springbok* 6. *Grant's Gazelle* 7. *Gerenuk* 8. *Impala*

the ugliest of the gazelles. It is more like a sheep than an antelope, with a large head and a bloated face. The fur is yellowish or rusty-grey in colour, shorter in summer than in winter. The length of the body is from 50 to 52 inches. The animal stands about $17^1/_2$ inches tall and weighs between 88 and 100 pounds.

The range of this gazelle has decreased in modern times and it was once so reduced in numbers as to be in danger of extinction. The Soviet zoologist, Bannikov, reported on the saiga to a Conference of Game Biologists in Paris in 1957. At the beginning of the twentieth century, the saiga was in decline and hunting was prohibited in the Soviet Union from 1919.

The decline, however, continued up to the year 1930 and Bannikov reckoned that only ten herds of the once-widespread saiga remained. After 1930, the animals began to increase so that the ten inhabited regions became linked again. The species is now distributed over an area of one million square miles, and the population is estimated at two million. Of this number, half a million are found in the Ukraine. The population density is from 8 to 10 animals per square mile.

The saigas are animals of the steppe and are found in lowlands and hilly plateaux. They like undulating ground and are found at altitudes between 2,000 and 3,000 feet. They are grazing animals and Soviet zoologists have found that their diet is not varied, being limited to a small number of steppe plants, many of which contain salt. In winter, the animals eat reeds and club rushes. In spring, the saigas obtain all their water from the plants they eat, but in times of drought they require water and migrate considerable distances to get it.

The mating period of the saiga in the Ukraine begins at the end of November and ends about the 20th of December. In Kazachstan and Mongolia, the season lasts about ten days. The males gather a considerable harem of females, varying in number, according to Bannikov, from forty to fifty. The males fight fiercely and such fights often end in the death of one of the rivals. The males do not eat during the mating period, but frequently swallow snow. Sometimes they will attack man. During this period, they are very weak and fall easy victims to frost and beasts of prey. The number of males which perish in this way can be as high as 90 per cent. As a result of such losses, the number of females is always much higher than the number of males.

Pregnancy last 145 days. The females assemble at certain places to give birth to their kids. In 1957, Soviet zoologists discovered one such gathering place and were able to mark 4,000 kids with special ear tabs. Marking in this way is now standard practice in the study of ungulates as it helps in the study of movements and migration and enables the zoologists to keep track of individuals.

Saiga Antelope
(head of buck in summer and winter)

The next group have one feature in common, all are adapted to life at high altitudes. Otherwise, they do not resemble each other very closely. Some resemble sheep and goats; others are more like bisons. All the chamois have bare muzzles and short tails and the females have two pairs of teats. Both sexes have horns. Members of this group are found in South and Central Europe, Central Asia, China, Japan, Thai-wan and in the North-western area of North America

The **Goral** is about the size of the European chamois but with a short neck. It is about 4 feet in length and stands 29 inches tall at the shoulder. It has a short head and black conical horns about 6 inches long. These tend backwards but are not twisted. The fur is yellowish-grey in colour, lighter on the front of the head. The chin and throat patches are white or yellow. The goral is found in the sea coast regions of the far eastern U.S.S.R., and in Manchuria, Korea, China, Tibet, Burma, Assam, Nepal and Kashmir. It lives on rocky terrain at high altitudes and is driven down only when the snow lies deep. It is a skilled climber and sure-footed when leaping down the face of steep cliffs. In some regions, for example the Soviet Union, the goral is protected throughout the year.

Goral

Gorals are usually found in small herds. They graze in the morning and in the evening, and spend the day resting among rocks near their feeding ground. They use the same resting places for long periods of time, so that their beds become padded with cast fur. The senses of smell and hearing are highly developed, but sight is not so good.

In winter, the goral can be seen in places which are clear of snow, when it feeds on the twigs of trees and bushes and on lichens and mosses. In the spring it eats juicy herbage. The mating season is in October and the females give birth to a single young early in June of the following year. Twins are exceptional. The females give birth to their young high among inaccessible rocks.

The **Serow** differs from the goral in having well developed facial glands. Like the goral it has scent glands between its toes. Ten geographical races of serow have been described, some of which reach an overall height of $3^1/_2$ feet. The horns are short, almost straight, and ringed. The neck is covered by a thick mane which becomes pure white in old males. The colour of the body fur varies from black to red and brown.

The serow is found mainly in the mountainous regions of China, Burma, Assam, Nepal, Kashmir, Indo-China, Siam, Ma-

laya and Sumatra, and is an inhabitant of rocky slopes and deep gorges with thick vegetation. It is a shy animal and in some places also rare. Serows are usually solitary, but small groups of four or five can be seen feeding together in the morning or evening. During the day, the animals lie up in thick cover and do not move unless disturbed. Their day resting places are used over a period of many years and some observers record that at such places layers of dung eighteen inches thick can be seen.

Serow

The **Rocky Mountain Goat** is found in the mountains of North America and Northern Alaska. It is a high-shouldered, bearded, pure white animal, obviously a goat, with short, back-curving horns up to 9 inches in length. An adult male will stand between 35 and 40 inches tall at the shoulder and weigh between 200 and 300 pounds. The hair on the throat and cheeks lengthens into a thick mane reaching to the knees. The Rocky Mountain goat lives at a height of 13,000 feet near the snow fields, and does not come down to the valleys even in winter time.

Living at such heights, the Rocky Mountain goat has to be satisfied with poor pasture. In winter it feeds on mosses and lichens. Besides this it eats at other times grass and the twigs and leaves of stunted bushes. Led by an old male, small herds can be seen all the year round, between the rocks and the snow fields. The animals like areas of rocky debris best. They can travel with ease across sheer rock faces where there is no obvious foothold, the literature abounds with accounts of their surefootedness.

The females give birth to one or two kids in April or May. At the age of a few days the kids are able to follow their mothers over the roughest ground and up the steepest slopes. A few kids are killed by golden eagles, but many die in avalanches.

The fur of the Rocky Mountain goat is dry and without any fat, with the result that rain quickly soaks into it. Under natural conditions, the goats seldom experience rain — snow is more familiar to them — so the lack of waterproofing is no disadvantage. Animals kept in zoos, however, have to be protected against the rain.

The **Chamois** is a typical inhabitant of the high mountains of Central and South-

Rocky Mountain Goat

Chamois

ern Europe. Chamois from the Tatras, the Alps and the Caucasus differ considerably in size. The chamois of the Alps measures between 4 and 6 feet in length with a tail of 3 to 4 inches. Overall height varies from 27 to 31 inches and weight from 90 to 100 pounds. The summer fur is reddish-brown in colour with a black stripe on the back. The face is striped white and yellow and there is a yellowish stripe on the rump. The hair of the summer coat is shorter, averaging about an inch in length. The winter fur is almost black or black and brown in colour and white on the abdomen. The legs and head are yellowish-white. In winter the hair on the back reaches a length of 8 inches, forming a mane from between the shoulder blades to the root of the tail. The difference in length between the summer and winter fur makes the animals seem slim in summer and thickset in winter. The skin of the chamois was once the source of the domestic chamois leather, but this market is now supplied with the skins of sheep and goats.

Males are always more robust than females. Both sexes have short horns which grow upwards then backwards to form a hoop. The kids grow their first horns as yearlings. In the first year, the horns measure $1^1/_2$ to 2 inches in length; in the second year they increase in length by $3^1/_2$ inches; in the third by 2 inches; in the fourth by one inch; in the fifth by one-eighth of an inch and in later years by only a few sixteenths of an inch. Each year's growth can be seen on the horns, as a result of which age can be estimated with a high degree of accuracy. Working on this basis, it seems the chamois does not live longer than twenty-five years.

Both sexes have scent glands on their napes close to the horns. These are surrounded by a skin muscle and their secretions play some part during the mating period. Like the goral, the chamois has hard hoofs, the edges of which project beyond the inner part, thus enabling the animal to move on steep mountain faces.

The chamois is found in the Cantabrian mountains of Spain, the Pyrenees, the Alps, Abrusa mountains, in the High Tatras and the Carpathians, in the highest ranges of Yugoslavia, Albania, Bulgaria, Greece, in the Caucasus and in the eastern parts of Asia Minor. In the High Tatras the chamois live in the alpine meadows above the forest limit, whereas in the Alps they are found in the region of the forest limit and the dwarf mountain firs. It is assumed that the chamois of the High Tatras originally lived lower, but pressure of tourists and the populating of higher regions pushed the animals upwards into the high meadows. The chamois of the Alps, Northern Bohemia and

the Jesenik mountains spend the whole winter in the forest zone, whereas those of the High Tatras stay more or less on the high ground. The main food of the chamois is mountain vegetation and in summer they are especially fond of mountain clover. In severe weather the animals are forced to migrate to lower ground, where they feed on the buds of trees such as willows, mountain ashes and birches, and the needles of the dwarf mountain firs. When severely pressed, they will eat even mosses and lichens.

Chamois are gregarious animals and can be seen all the year round in smaller or larger groups consisting of old females and young males of two, or rarely, three years of age. The leader of each group is always an old female. Old males lead a solitary life.

The **Takin** is still a classification problem for zoologists. It bears some resemblance to the gnu. Formerly, it was classified as a chamois, but it is in fact closely related to the musk-ox. There is something of the chamois, the goat and the cattle beast about it. It is a small, short-legged, sturdy animal with a shaggy coat, standing about 5 feet tall in overall height. The line of the back slants slightly downwards towards the rump. There are no facial glands or glands between the toes. The tail is short and thickly haired. The back varies in colour from yellowish-grey to black. The horns are short but strong, and close-set at the roots. They resemble the horns of the gnus.

The takin is found mainly in hilly areas of West China and the Mishmi mountains of Northern Assam. Four geographical races have been distinguished, but little is known about their way of life. According to Lanick, takins inhabit the wild rugged mountain areas with a thick overgrowth of rhododendrons, near the timber line. Bourliere states that the animals live in zones thickly covered with trees, in bamboo and rhododendron jungles of the distant Himalayas, and South-west China. Schafer agrees with this for he encountered takins in these places. The takins tread their pathways through the thick bamboo growth mainly at a height of 15,000 feet. In winter they form herds of about three hundred animals under the leadership of an old male.

The rutting season is in July and August and the females give birth to a single calf in March or April of the following year. Cows leave the herd to tend their calves which are weaned after about four weeks.

Musk-oxen have been divided into three geographical races. They are stout, muscular, rather clumsy animals with heavy horns forming a frontal shield. Zoologically they stand midway between the bisons and the sheep. The head is bison-like, the neck and tail short. The short tail is hidden in long hair. The shaggy hair, which hangs down under the neck and from the body, reaches a length of 27 inches. Facial glands

Takin

are well developed, especially in the case of old males, and there are glands between the toes of the fore and hind feet.

The **Musk-ox** is an inhabitant of snow fields and tundras in North Canada and Greenland and on some islands of the Canadian Arctic. During the first half of the nineteenth century, musk-oxen ranged all over the northern region of the American continent, from Hudson Bay to Alaska. Southwards, their range extended to the Great Bear Lake and the Slave Lake. As long as the animals were being hunted by Indians using primitive weapons they were in no danger, but after the white settlement they were faced with extinction.

The musk-ox is the real inhabitant of the far north. In the Ice Age it ranged over the tundras of Europe, Asia and North America with the mammoth and the reindeer. Fossil remains show that at this time it lived in Europe as far south as the Pyrenees and the Danube. In America, it ranged as far south as the Gulf of Mexico.

A male musk-ox stands about 4 feet tall at the shoulder and measures about 8 feet in length. Greenland musk-oxen are about 7 feet long and stand about 4 feet high on the average. Northwards, the animals become smaller and smaller. Cows measure about 6 feet in length and stand about 44 inches tall. The general colour is black-and-brown, which varies with sex and age. Old bulls are paler in colour than young ones. Cows are always darker than bulls. Very often there is a pale facial patch. The feet and lower legs are yellow-and-white in colour. The horns of the males grow to about $23^1/_2$ to $27^1/_2$ inches in length; those of the females do not exceed 15 inches.

Musk-ox

In 1958, Professor A. Pedersen described the habits of the musk-ox as follows:

"The musk-ox is found singly, in small groups or larger herds, on the vast wastelands of the far north. Old bulls lead a lonely life after being driven out by stronger rivals. Sometimes an old bull will return to re-establish his leadership of the herd, but, as a rule, once he is deposed he is doomed to lead a lonely life. Very often, several of these bulls join together to form groups of about four animals. These solitary bulls make long migrations. They can be seen not only in good pastures, grazing apart from the herds, but also in far distant lonely places in high mountains or on small islands. They frequently visit the so-called nanutaks, the ice-free peaks above the glaciers. The biggest herd I have ever seen consisted of twenty-two animals. More usually, the number is six. Each herd is led by an adult bull."

The musk-ox does not like to jump and prefers to wade across a brook or river. It is not selective in the matter of food and will eat anything which grows on the barren land. The mating period starts in

July and goes on into August. Pedersen remarks that the males fight fiercely and that such encounters are often prolonged. The gestation period is eight and a half months and the females give birth to their young at the beginning of May. The young animals are highly resistant to cold but do not stand up well to moisture or melting snow. They are able to run within a few hours of birth.

Musk-oxen are not shy and show little fear in the presence of man. As a result, they frequently fall victim to hunters, but wolves are their main enemy. The animals defend themselves against wolf attack by ranging themselves in a circle with the young animals in the centre. The animals forming the ring await the attack with their heads held low. If attacked, they defend themselves with their horns. During severe snow storms the animals bunch together, again forming a circle, with the older bulls on the outside and younger bulls, females and calves in the centre. Such a group is frequently totally covered over, temporarily, by the snow.

Although the musk-ox has short legs, it can run at considerable speed. It is hunted by Eskimos and Indians for its meat and hide.

Goats are strong animals with relatively short legs. Both sexes are horned. The horns have rings and are usually arched, but can also be turned or twisted. Under the tail there are two scent glands. Most goats have no glands between their toes. Typical of the goats is the beard. The muzzle is completely covered by fur. All the wild goats are mountain species.

The **Domestic Goat** is not the descendant of any single wild ancestor but of several types. One of its forebears was the extinct Celtic goat. Another was the Pasang of Western Asia. The Markhor of Asia was the ancestor of the Oriental goats and the modern Circassian breeds. Man has raised goats in many varieties, some selected for the production of milk, others to supply meat and hides. A good milking goat can give between 110 and 200 gallons of milk in a year. Some races, for example the white hornless breeds, have yielded as high as over 300 gallons of milk in a year. Goats bred for food weigh between 65 and 130 pounds. Some races, which can be regarded as substitutes for sheep, are bred for their wool. The Angora goat is a valuable wool producer and is raised mainly in the Turkish mountains. The Kashmir goat, which stands only 23 inches tall, and the Chinese goat, are notable for their long, yellow fur.

In mountain regions, goats are taken out to pasture every day. In other parts of the world, the herds spend the whole spring and summer in the open. They graze the slopes and climb apparently inaccessible places. Herds of uncertain breeding produce many colour variants — mottled, white, rust and black. Some have long fur, some have short. Horn shape also varies, but most goats have their horns turned backwards. Some have spiral horns.

Goats prefer to browse on the leaves of trees and bushes rather than to graze. In the south they are therefore a great threat to forests, and in regions where goat numbers are high on the ground, the forests are being destroyed. In some places the grazing of goats is prohibited.

Wild Goat

Wild Goats in Britain are the descendants of gone-wild domestic animals.

The wild goat has sharp arching horns, tending backwards. They have ten to twelve rings and measure up to 42 inches in length. The wild goats are bigger than any of the domestic varieties. A fully grown male will measure up to 5 feet in length and stand 3 feet tall to his head.

The general colour is red and grey on to the top of the body and sandy-yellow on the flanks. There is a black dorsal stripe and a wide dorsal stripe between the neck and body. Both sexes have the typical thick goat's beard.

The wild goat is found on some of the eastern Mediterranean islands, and in Asia Minor up to the Caucasus mountains, South Turkmenia, Baluchistan, Iran, Afghanistan and West India. Stroganov has described the life of these animals on the territory of the U.S.S.R.:

"Like other mountain animals, the wild goats migrate in summer to the mountains and return to the lower ground in winter. As soon as the snow falls, they remain mainly on the southern slopes. The mating season begins in the second half of November and ends in the first half of December. At this season the males fight fiercely. After mating, they separate from the females. The young are born in May and June. For a few days after the birth of the kids, the females remain withdrawn from the main herd. Later on, the nursing females form herds again. Males remain in the herds up to their fourth or fifth year. Old males lead a solitary life or form special herds of about twenty animals."

One of the last strongholds of the wild goat is the island of Crete, but even here the animal is threatened with extermination. In 1952, Zimmermann wrote of them:

"At present, the hunting of wild goats is prohibited. In Samaria, however, it was evident that the herders had not given up their ancient rights and it looks as though the last wild goats will soon be exterminated unless the Greek government finds some effective means of protecting them."

In 1963, the German zoologist, Schultze-Westrun, published a long report about the condition of wild goats in the Aegean Islands. It is obvious from his report that the Greek government has undertaken effective measures to protect the animals. There is now no danger of their extermination and animals are being introduced to other islands in the group.

The **Markhor** is about the same size as the wild goat. Its summer coat is light brown in colour. In winter, the coat is lighter and thicker. The horns, which are set close together, spread out and up-

XVI 1. *Mouflon* 2. *Barbary Sheep* 3. *Chamois* 4. *Siberian Ibex* 5. *Bighorn Sheep* 6. *Markhor* 7. *Argali*

wards forming a corkscrew, and are 4 feet in length. Four races have been described on the basis of the number of screws on the horn. The markhor is found in Soviet Turkestan, Uzbekistan, the Tadjic Soviet Republic, Afghanistan, Kashmir and Baluchistan. It inhabits rocky ground on forested mountain slopes. Where there is no forest cover it lives in the high valleys.

During part of the year, markhors live in large herds, but during the summer the males remain on higher ground, coming lower in the morning and evening to graze. The name *Markhor* is of Persian origin and means snake-eater, but there is no evidence that the animals eat snakes.

Markhor

The **Ibex** resembles the wild goat but its horns are rounded at the front instead of edged. In cross-section, they are triangular in shape and the grooving is very striking. In Europe, the ibex is now found only in the Alps in a small area of Northern Italy, but it has been introduced to special reserves in Switzerland and elsewhere. In Asia, it is found in the mountains of Russian and Chinese Turkestan, Central Siberia, Kashmir, Afghanistan, Palestine and Arabia. There are four geographical races.

The **Alpine Ibex** is a powerful, graceful animal measuring between 4 and 5 feet in length and standing between 30 and 40 inches tall. The male is bigger than the female. The tail, which is carried upright, is about 5 inches in length and can be seen from some distance away. The legs are relatively short. Males and females have horns. The head is short and typically arched. Age can be estimated according to the number of rings on the horns. But in the case of old males this estimate becomes inaccurate. The horns

Ibex

of adult males reach a length of 3 feet and weigh between 20 and 30 pounds. The horns of the females are shorter and lighter.

The colour of the alpine ibex varies with age and season. In summer, it is usually a dark shade of brown and grey, or red and grey. The winter coat is paler. Some animals have darker spots on their heads, chests and flanks. The lower legs are dark, or even black. The rear of the hind legs, the area under the tail and part of the abdomen are white. The dark dorsal stripe is not as striking as in a wild goat and in females is missing altogether.

The Alps are the stronghold of this species, and according to the Swiss zoologist, Bauman, it lives in the alpine zone above the forest line up to the limit of permanent snow. It prefers alpine meadows with scattered stunted strees and pasturage among the rocky cliffs. It lives higher than the chamois and only the most severe winter weather will drive it to lower ground. Exceptionally, it will be found down at the limit of the tree line. Generally, it winters at a height of 7,500 to 10,500 feet above sea level. It moves with incredible surefootedness and skill among the most inaccessible rocks.

Adult females with their kids, and young males, form herds. Outside the mating season, mature males lead a solitary life.

During the summer, the ibexes graze from early morning onwards, working their way uphill as they do so. In the evening, they graze downwards again. Like the chamois, the ibexes shift ground according to the weather. During hot days they move to cool, shady places on northern slopes; in winter they choose south-facing slopes. They rest at midday, choosing places giving them a commanding view. Even when calmly ruminating, they are constantly on the watch. They eat much the same food as the chamois.

The mating period is in December and January. During this season, the males fight but not fiercely. However, it sometimes happens that one male pushes another into a crevice from which he cannot escape. Five months after mating, usually in June, the female gives birth to a single kid. In exceptional cases, she may give birth to twins. Soon after birth, the kids run with their mothers and climb with them among the rocks. The female nurses her kid throughout the year. Ibexes become sexually mature in the fourth year of life.

Ibexes were found throughout the Alps into the fifteenth century, but their numbers were, thereafter, steadily reduced by methodical killing. By the nineteenth century, their numbers were reduced to sixty, all in the Italian alps. Despite severe penalties, they were brought to the verge of extinction by poachers, who hunted them for trophies and meat. They were saved by the late king, Victor Emmanuel II, who declared their range to be Crown Land and prohibited all shooting of females. In 1920, the whole territory was declared a National Park. As a result of these measures, the alpine ibex was saved from extinction.

From their reservation the ibexes began to spread to neighbouring regions, or were introduced by man, for example to Switzerland. The animals are now established in the Italian and Swiss alps and there are herds in the French, Austrian and Yugoslavian alps.

A census carried out in 1953 by Dr. Haltenroth estimated the total number of alpine ibexes to be 3,336. This is not a very great number considering the vast area of the Alps.

The **Siberian Ibex** is commoner than the alpine and is found in the high mountains of Central Asia. It closely resembles the alpine ibex, but is a bigger animal with more powerful horns, reaching a length of up to $4^1/_2$ feet.

In Pamir, the Siberian ibex lives above the forest limit from 8,000 to 15,000 feet. Unlike the alpine ibex, it regularly comes down to the forest zone in winter and in the Altai region it can sometimes be seen as low as 1,600 or 1,900 feet.

In the Soviet Union and Mongolia, it is looked upon as an important game animal, but only the most skilful hunters are able to stalk it on its high, rocky, dangerous territory. In most cases only males are hunted, and in Mongolia about 5,000 animals are killed every year.

The **Spanish Ibex** measures between $4^3/_4$ and 5 feet in length and stands 29 inches tall at the shoulder. It is found in some of the mountains of Spain. It has lyre-shaped horns up to 3 feet in length which are pear-shaped in section. The Spanish ibex closely resembles the alpine ibex in colour but is somewhat paler. Otherwise, it differs little from the others in appearance and general habits.

Spanish hunters kill the ibex for its excellent meat and it is a remarkable fact that the males are not so wary as the females. They take up their position at the rear of the herd, so it is possible for the hunter to approach them when the wind is blowing from the herd to him. The surprised ibex, instead of running away, jumps on to a rock and looks round to see what is going on. Thus, the hunter is given a clear shot.

The Spanish ibex is now extinct in the Pyrenees.

The horns of Spanish Ibex and Caucasian Ibexes

The **Caucasian Ibex** was until recently almost an unknown animal, and the main details concerning its biology come from the reports of Soviet zoologists. The Russians call it the Dagestan bison and thus differentiate it from the ibex. The most important feature of the Caucasian ibex is the shape of its horns which are more like those of a sheep. They are strikingly twisted. The horns of the males reach a length of 27 to 29 inches. This species is about the same size as the Spanish ibex and weighs up to 220 pounds. The beard, which is of short hairs, grows forward under the chin and does not overlap the mouth.

Himalayan Tahr

In the western part of the Caucasus, up to Kazbek, there lives a special race, the so-called **Severtz's Caucasian Ibex.** Its horns form a simple arch like those of the ibex and it has a long, loose beard.

The **Himalayan Tahr** is goat-like without the goat's beard and its horns are edged in front. Males and females have horns of approximately the same length. This species has long fur to protect it against the severe cold of the high mountains. Its general colour is grey and white, or slate-grey. The throat is a dirty white colour. Around the eyes there is a red or brown stripe reaching to the throat.

The Himalayan tahr inhabits the Himalaya mountains, usually in the forest zone, or in rocky areas up to a height of nearly 10,000 feet. It is also found in West India and Arabia. During the mating period, the male emits a powerful odour.

Bharal

The **Bharal,** or **Blue Sheep,** is found in Tibet and the surrounding mountains. According to Schafer, who has published the most recent information on this species, the blue sheep measures from 48 to 53 inches in length, reaches an overall height of 30 to 35 inches, and weighs up to 165 pounds. The summer coat is grey and brown in colour. In winter, it is grey and brown with a bluish tint, hence the name blue sheep. The fur of the males is darker than that of the females and Schafer writes:

"The mating period, according to my observations, is at the beginning of October. At this time, I could see old males chasing females, but I have never witnessed any fights at all. I learned that the blue sheep are tolerant, gregarious animals. They avoid any kind of forest cover, or even bushes, and are never to be seen among trees. They prefer the open mountain crags or areas of broken rock. Their resting places can be found on the steepest terrain. When being pursued, the blue sheep tries to reach the highest ground, and even wounded animals will try to escape with the rest of the herd and die in crevasses or snow fields. The number of animals in a herd varies widely. I saw

herds consisting of two and even four hundred animals."

Coming to grips with the blue sheep in the rocky, mountainous terrain is not easy, for their grey and bluish fur matches their surroundings perfectly. One can see the animals only when they are moving quickly. As the blue sheep, like the Himalayan tahr, is neither a goat nor a sheep, we call the blue sheep semi-sheep and the tahrs semi-goats.

The **Barbary Sheep,** or **Audad,** differs from goats in having no beard and by the absence of smell in the males during the mating season. However, it does resemble the goats in having a long face and a flattened tail with a naked underside. It has no facial glands under its eyes. Adult male Barbary sheep measure up to 6 feet in length, and stand 3 feet tall at the shoulder. They have strong bodies and stiff brown or red-and-brown hair, which lengthens into a thick mane on the throat and chest and reaches almost to the ground. When the ram lies down it rests on its mane as though it were a pillow. The males have powerful horns curving backwards, which are triangular in section and rounded at the front.

Barbary sheep are found in the mountains of North Africa and in Ethiopia and Kordofan. They live on the highest mountain ridges and are therefore difficult to hunt. The mating season is in December and at this time each ram gathers several females. Outside the breeding season, the animals lead a solitary life. The Arabs admire the rams, which will stand for thirty minutes at a time butting each other with their heads held low. These sheep feed on juicy plants in summer and on lichens and dry grass in winter.

Barbary Sheep

Barbary sheep are widely kept in zoological gardens.

Sheep differ from goats in having a flattened forehead and facial glands as well as glands between the toes. Their horns curl downwards. The tail is fur-covered on the upper and lower sides and is not flattened. The tail of the sheep hangs downwards. During the mating season, the rams do not smell. Sheep have no beards, but otherwise they resemble the goats in their general way of life. They live in the high mountains and are found in Central and South Asia. Man has tamed some of the wild sheep, bred them in great numbers and introduced them to all parts of the world. Domestic sheep, however, are neither so intelligent nor so skilful as their wild ancestors. They are of great use to man. They give birth to one, two or three young. The lambs become self-supporting in a very short time and are sexually mature in the second year of their life.

The **Mouflon** was once common in the mountains of Europe, but is now found there only in Sardinia and Corsica, and even on these islands its numbers are now sadly reduced. To save the species from extermination at the hands of poachers, goatherds, and other irresponsible hunters, special reserves for the mouflon had to be created which are watched over by guards. Specimens were introduced to Central Europe where they became acclimatised and bred, so that the species is far more numerous on mainland European reserves than in Sardinia and Corsica. Czechoslovakia now has the greatest number of these animals.

The mouflons of Czechoslovakia have stronger horns than those of Corsica and Sardinia. They are also bigger bodied animals, standing 25 to 29 inches tall at the shoulder and measuring 39 to 48 inches in length. Old rams reach a weight of up to 110 pounds, females are about a stone lighter. The horns almost touch one another at the root, are very strong and turn downwards in snail fashion. The horns of the males begin to grow at the age of four months and in fully adult animals measure between 27 and 31 inches in length. The record horns from a ram in Bohemia measured 38 inches. The best horns come from rams at the age of twelve or thirteen years. The females are usually hornless.

The fur of the mouflon is rough and rusty-brown in colour, darker on the head; the abdomen is creamy-white. There is white on the inside of the lower part of the legs and round the muzzle and the eyes. The rump patch is also white. In winter, the fur is much darker and the rams have a long mane under the throat and chest. They have also two square-shaped marks, forming the so-called saddle on their sides. These marks are especially noticeable in winter.

In Sardinia and Corsica, the mouflon lives in the high mountains on rocky terrain. In Czechoslovakia it thrives in continuous forests as well as on mountains and plains, and it may be that this habitat is more suitable to it, and that here it has returned to the kind of habitat its ancestors occupied in the pre-historic period when the species lived in Central Europe. Certainly, the mouflons in Cze-

Mouflon

choslovakia reach greater weights, breed better and develop more powerful horns than the animals of Sardinia and Corsica. The animals live in small groups and when resting or grazing there is always one on the alert, usually an old female.

S. Mottl, writing about mouflons in 1957, recorded:

"During the mating period the groups are watched over by an old mouflon that is also the leader, but this cannot be regarded as an invariable rule because, sometimes, a group is watched over by a female. If the sentinel sees danger it emits a shrill whistle and the group runs off immediately. After covering a short distance, the animals pause to look round and then continue their escape. They are able to jump over high obstacles almost from a standing start. When going out to graze or when returning to their resting places, especially in the morning and evening, the mouflons utter short, bleating cries, very similar to those of the domestic sheep. The young animals bleat like the lambs of domestic sheep. It is obvious that these sounds have a particular meaning for the group. I succeeded several times in making a group change direction by imitating these sounds from a hiding close by. In some cases, these shy animals came very close to me. The scent glands also play an important part in the everyday life of the group, although it seems that these are not so important to sheep as they are to deer. The groups are led in most cases by an old female. Only in the winter does the old ram remain in the group with the females, younger males and lambs. In summer, the groups are smaller and are composed of females and lambs with young males up to two or three years of age. Old males range the territory on their own, or form small units of two or four. They are very crafty."

Asiatic Mouflon

In September, the rams begin searching for females and fight with rivals. This is the time of mating which lasts approximately from October to mid-December. In Sardinia, the mating period takes place from the middle of August to the end of October, in Corsica from September to November, while in Germany the period is December and January. The rutting ram drives off all other males except young males up to two years of age. Before fighting, and during the short interval between fights, the rivals go through the motions of grazing. They scrape the ground with their front hoofs and smell the uncovered leaves, but all the time they are watching each other carefully. Suddenly, they turn to fight again. The distance between them is about 65 feet. At first they walk slowly, then they break into a run and clash, horn to horn, at full speed. Such clashes can be heard a long distance away. During these engagements, the females stand close by, sometimes grazing with apparent unconcern. The fights end fatally only in rare cases; the weaker rival usually runs away after a time and is not

pursued by the victor. The rams fight outside the breeding season, but such fights are not so fierce and may be mere play-acting.

Mouflons adapt themselves readily to new surroundings and new food. They feed mostly on plants and grasses, but in winter they browse trees, raspberries, heather and black-berries. In autumn, they eat acorns and the fruits of various trees and bushes. They will even eat such plants as the sowthistle and spurge.

According to some zoologists the most dangerous enemies of the mouflon in Czechoslovakia are vagrant dogs, which pursue them all the year round. The sheep are easily killed during the winter when the snow is deep, and in spring when the females are pregnant. Two dogs can kill a strong ram. Some dogs become specialists and spend much of their time in the forest hunting mouflon and other game.

Geographical variability of Asiatic Mouflon — Persian race, Kashmir race, Turkestan race and Argali

The **Asiatic Mouflon** is closely related to the previous species, but its horns are more flattened and have a sharp front edge. There is no saddle. This species inhabits the south and west of Soviet Turkestan, Cyprus, Asia Minor, Persia, Afghanistan, Kashmir, the Punjab and Baluchistan. There are a number of geographical races and Ellermann and Morrison-Scott have described twelve. These differ mainly from each other in the shape of their horns and body size. The female gives birth to two lambs and sometimes triplets.

The **Argali** is the biggest of all wild sheep, measuring up to $6^1/_2$ feet long, standing more than 4 feet tall at the shoulder and weighing 350 pounds or more. The females are smaller and lighter than males. Old rams resemble great muscular athletes. They have an elongated head and a short, powerful neck. Their massive horns sweep backwards and outwards, then forward at the tip, sometimes making more than a complete turn. In some animals, the horns will measure 60 inches round the curve and 14 to 19 inches in circumference at the base.

The summer fur is yellow and brown in colour. After the autumn moult the thick woollen hair is black and grey, with the throat, chest and abdomen darker than the upper part of the body. The rump patch, or mirror, is grey and white.

The argalis are found in semi-desert areas of Siberia, Mongolia and Tibet, and there are about fifteen geographical races. In Central Asia they inhabit the rocky steppes of Pamir and Tien-Shan, but in some areas they live at lower altitudes, for example in the Kyzyl Kum mountains. One observer reports that these sheep live on the flat, treeless ridges

of the steppe. They avoid forest-covered regions and steep slopes and are rarely seen among rocks. Professor Turov says that the argalis of the Altai reservations rest during the day on rocky heights, under cliffs, in gorges and glacier valleys near small lakes. They move down to the lower meadows in the evening to feed and return to the higher ground at dawn. According to Bannikov, the argalis of the Altai Gobi region can be seen on foot only early in the morning or in the late evening, or during the night. During the day, they lie up in inaccessible places. This pattern changes in winter, then the animals are on foot throughout the day searching for food. At this time they form big herds of up to one hundred animals. The mating period of the argali is in October and November, and the young are born at the end of April or the beginning of May in the following year. Old sheep give birth to their young earlier than less mature animals and often have two lambs. The lamb is wobbly on its legs for the first few days of its life and the mother remains with it constantly in rocky places where it can be easily hidden from birds or beasts of prey.

In some areas the argali is common, and in West Pamir, for instance, several thousand are killed each year. In some areas where they had been killed out completely, they have had to be reintroduced. The hides are of no particular value. The beast is hunted mainly for its massive horns which are of considerable value.

Argalis are divided into two basic groups. One of these is the **Marco Polo Sheep,** found in the mountains of Central Asia, Kazahstan and in the east up to the Irtysh River. The second is the **Siberian Argali** which has strong, short horns,

Bighorn Sheep

rounded in front. It is found in the Himalayas up to the Altai.

The **Bighorn Sheep** is smaller than the argali, but it has massive horns reaching a length of 27 inches round the curve and measuring up to 13 inches in circumference at the base. The horns are grooved but not ringed. Bighorn rams are heavily built animals, standing about 3 feet tall at the shoulder and weighing up to 380 pounds. The females are much lighter in weight and have narrower and smaller upright horns. The short fur is greyish-brown or black in summer. The rump, muzzle, throat and the insides of the legs are white. Otherwise, colouring in the bighorn sheep is variable, not according to season but according to geography. A number of races are recognised, separated by colour, horn structure and the shape of the ear.

It seems certain that the bighorn originated in Asia and entered North America by way of the Bering Peninsula. In the

Old World they are found from Jenisei to Kamchatka and in the south to Stanovoj Chrebet. In the New World they are found in the western part of North America to Arizona and Mexico. There has been a sharp decline in their numbers in North America and their main strongholds are now in reservations.

Bighorn sheep live in the most inaccessible mountains. Unlike the argalis, they do not like level terrain, preferring precipitous ground among rocks. In their general habits they resemble ibexes. They are gregarious and are generally found in flocks of up to fifty animals. They graze on the poor vegetation at high altitudes. They are agile and surefooted, with their hoofs specially designed for giving them a good grip on rocks. They prefer living high and come down to lower levels only when the winter is severe and the snow is lying deep. According to Turov, writing of the Old World race, the bighorns descend from the high mountains of Stanovoj Chrebet only when the winter is especially severe. In these regions, the thermometer sometimes falls to 50° below zero and there is so much snow that the animals cannot reach their food. Even when the sheep move down to lower regions and forests, many of them perish. Enemies of the bighorns are mainly wolves, but sometimes bears or even wolverines prey on the sheep. Lambs are frequently caught by birds of prey. The main natural enemy of the bighorn in the New World is the puma, but the puma apparently finds even the youngest bighorn a difficult prey.

Bighorn sheep occupy a relatively small territory and do not migrate except for short movements to lower altitudes during severe weather. They remain attached to their home ground throughout their lives.

Man long ago realised that the sheep would be a useful animal if it could be domesticated. In time he achieved this, but it is not possible to say with any certainty when he succeeded in doing so. Originally a hunter of the wild sheep, he became the herder of the domesticated animal.

It is unlikely that the **Domestic Sheep** originated from a single wild species. Considering the number of races evolved by man, it is likely that the domestic stock had several ancestors. It is presumed, however, that most of the races originated from the Asiatic mouflon. European races originated from mouflons and the Central Asiatic sheep most probably from archars. Russian breeders still crossbreed domestic sheep with archars to produce strains that can live in high mountain regions.

The domestic variety known as the Merino is noted for its extraordinarily soft wool. In some parts of the world, notably Australia and the Soviet Union, merinos are kept in vast flocks to provide wool not only for home consumption but for export throughout the world. Merinos are large sheep weighing up to 370 pounds and producing up to 46 pounds a year.

Many fine varieties of sheep have been bred in Great Britain, some for their mutton, others for their wool. A hardy breed which produces tasty mutton is the Scottish Mountain Blackface. Another type kept on grassy hills is the Cheviot. The English Border Leicester is a famous breed much used in crossing.

The **Karakul Sheep** produces excellent wool. It is raised mainly in Uzbekistan. This is a small, dark-grey variety. The adult sheep produce wool which is used mainly in the manufacture of carpets. The

best wool comes from lambs a few days old. It is lustrous black and curly. As the adult ages, the wool becomes straight and turns grey. Lambs are killed between the third and eighth day of life so that the wool remains curly and lustrous. These skins are the so-called Persian lamb.

Another type is the so-called Brechschwantz which also has smooth, tight curls, but in this case the lambs are removed from the mother's body before they are due to be born.

Some races of sheep are raised for their milk from which excellent cheeses are made. A good milking sheep will give almost as much milk as a good goat.

The **Hunan Sheep** of Tibet is used by the Tibetans as a beast of burden, just as the South Americans use the llama and the Arabs use the camel.

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