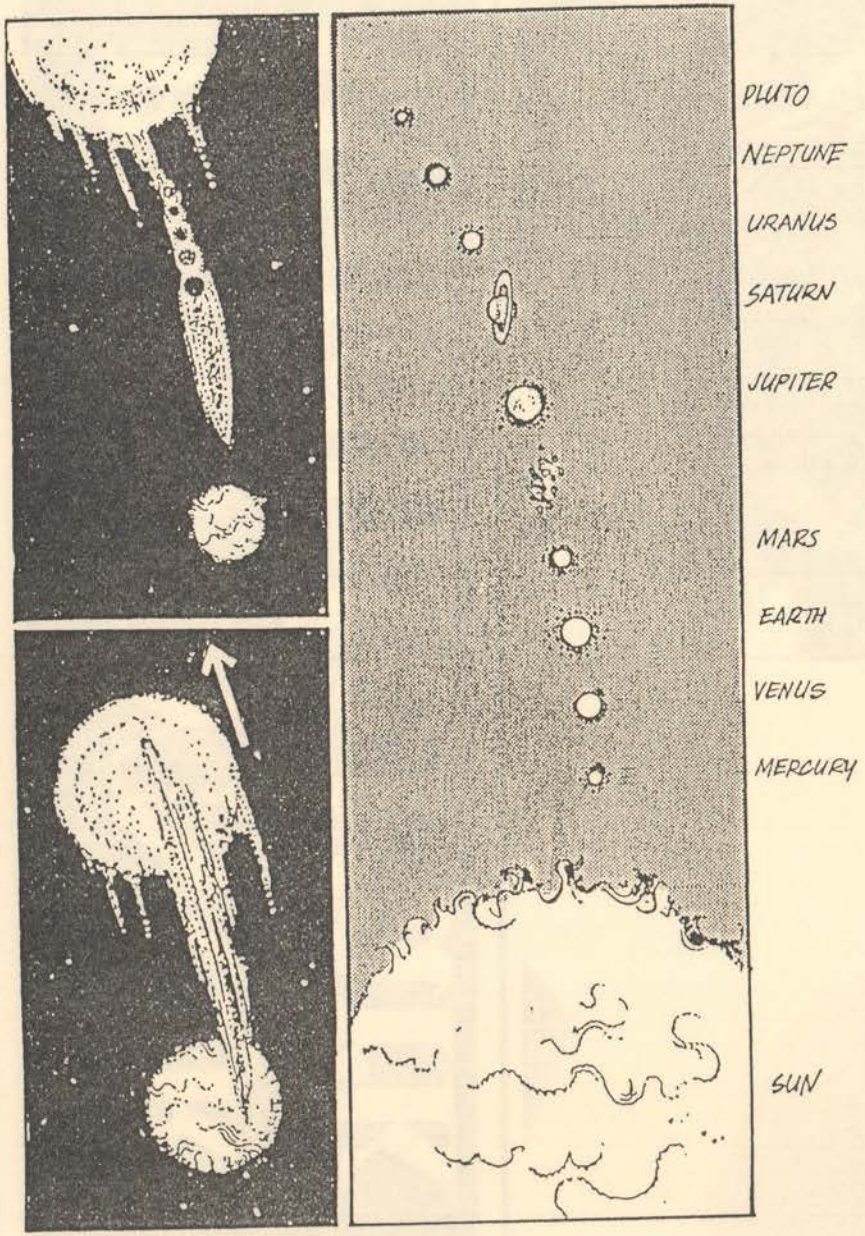
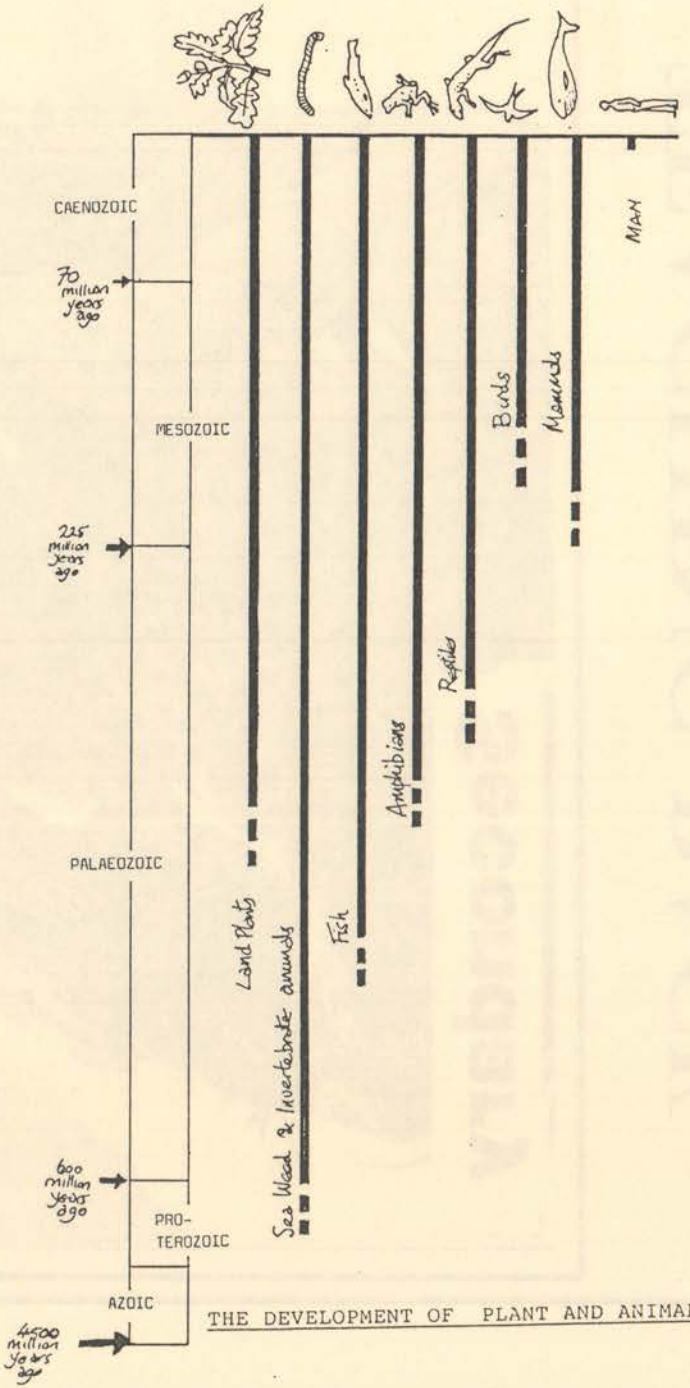
PENSCYNOR Wildlife Park

Secondary

TEACHING PACK

HOW THE WORLD WAS FORMED





THE DEVELOPMENT OF PLANT AND ANIMAL LIFE

SECTION 1

BACKGROUND INFORMATION PART 1

About 500 million years ago, a chain of events took place which were to form our planet Earth. A passing star came so close to our sun that it pulled a cigar shaped cloud of gases out towards it. In time, the globules which had been made, were to become the planets of our solar system. Earth was one of those planets.

Over the following millions of years, life on planet Earth developed to the point at which we know it today. Chart 1 shows how this happened.

Chart 1

During this time, the plants and creatures have evolved (changed) to survive in their 'home' environments. Those which were not able to do so invariably became extinct. Dinosaurs, for example, roamed the planet for more than 150 million years, but finally failed to change to new circumstances and became extinct.

There are two important principles which affect the survival of our wildlife:

1. Creatures need to develop their behaviour to meet the particular needs of the place in which they live, so that they can obtain food, find shelter and can reproduce themselves and raise their young.

   For example, we all know that most birds have wings and that these wings are usually used to fly with. However, penguins are birds and they do not use their wings to fly. Living in the extreme cold of the Antartic, penguins evolved to a point where they recognised that their food source was the fish in the Antartic seas. In this way their wings evolved to help them swim, rather than to help them fly. Other changes to penguins' bodies have also taken place, to further help them survive in this tough environment.

2. Evolution is still going on: around the world, animals are still undergoing change to be able to survive in their 'home' environment. This is especially true so far as behaviour is concerned. To change their appearance is clearly a more long term process. Changes associated with evolution often take long periods of time and several generations to complete. But in our planet's more recent history, the time taken to bring about a complete change to an environment has been considerably shortened. Indeed, large tracts of the Earth have been changed by Man.

WHY DOES MAN WANT TO CHANGE CERTAIN ENVIRONMENTS AROUND THE WORLD ?

1. BECAUSE OF RISING POPULATIONS

Throughout the world, the number of people living in various environments is increasing.Many scientists believe that the number of people alive on Earth is doubling at a faster and faster rate. By the year 2000 the present population of 4650 millions will have increased to 6300 million people.

The rates at which these increases are taking place are not equal throughout the world. The fastest increases take place in the regions where most of the world's 'natural environments' are to be found.

When the number of people increases at this rate, it is perhaps inevitable that a conflict arises about how the land should be used: should it be used to help the local people, or should it be used to maintain the environment and its wildlife ?

Often in the past, land has been used to help the people - either by providing more space to house them, or more land on which to grow food. The result has been that a smaller area is given over to 'natural environments' and the wildlife they support.

2. BECAUSE OF THE INCREASING IMPORTANCE OF INDUSTRY AND TOWN/CITY LIFE

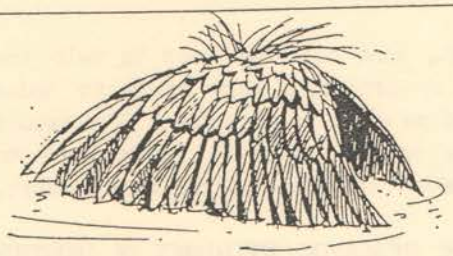
In Britain during the past 200 years, we have seen the gradual change from a rural way of life to a town/industrial way of life. In Victorian times Britain was called "the workshop of the world", because she made most of the world's manufactured goods. It was a process which brought great changes to the people involved in it. Now, much of what is known as the 'Western world' is industrial - obtaining a living by manufacturing various things.

When a country starts becoming industrial, two things happen to its environment:

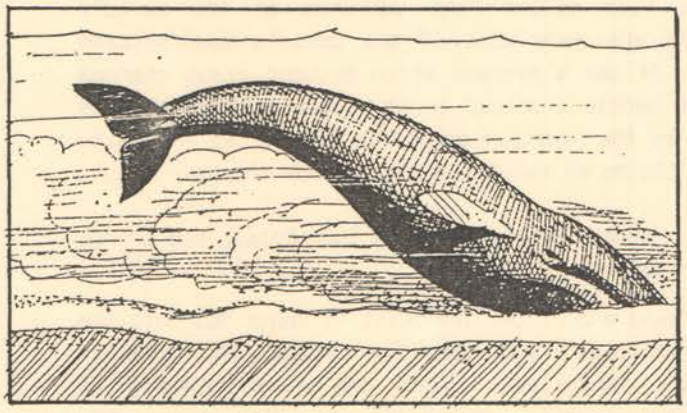
(i) Towns and cities are built to house not only the factories but also the people who work in the factories. Roads and other systems of communication are built to link these new centres of population. The new towns are often built in the 'natural environments', where wildlife had survived for perhaps many millions of years.

And

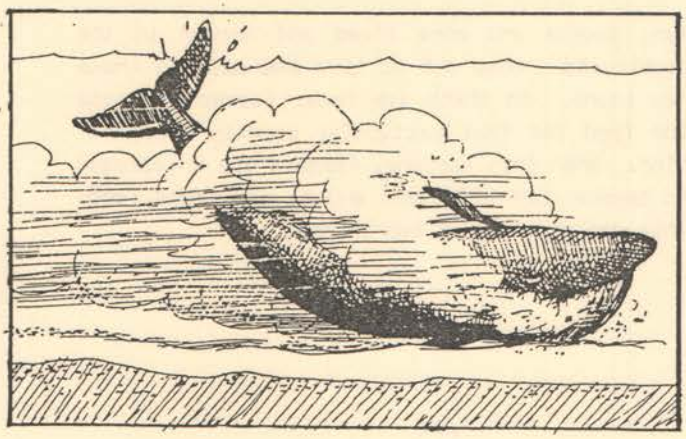
(ii) Many people who once lived and worked in the countryside, move out to live and work in these new towns. So there are fewer farmers to grow the food for that particular country's population. When this happens, farmers are encouraged to become more efficient and to grow more food. This can mean one of two things:

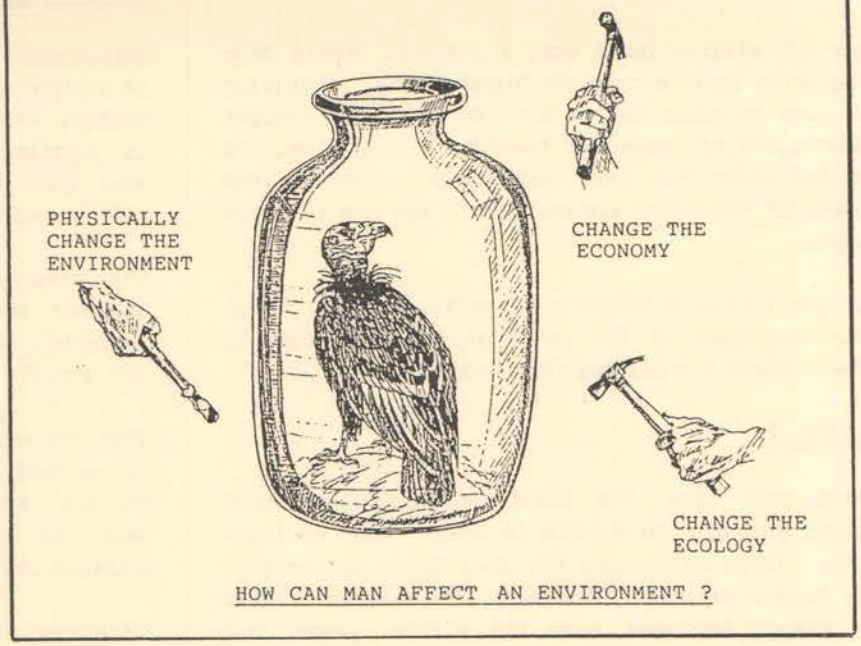


The BLACK HERON, in Africa, lifts it's wings over it's head while hunting. This helps because the fish swims into the shade, and it also cuts down the glare on the water.

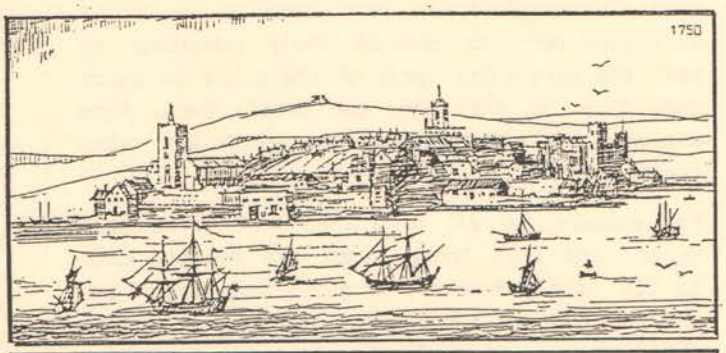


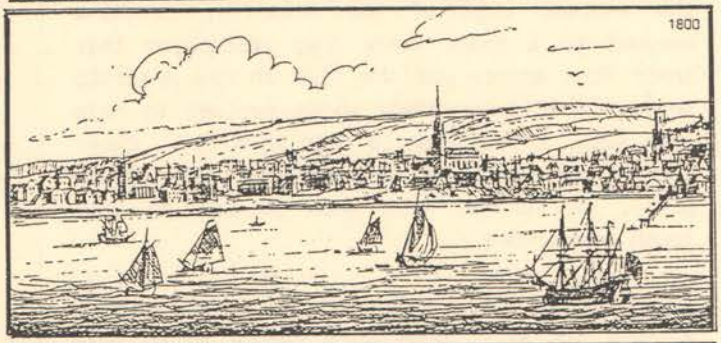
The BLUE WHALE learns to adapt to its environment. To get food the whale stirs up the sea floor by this form of nose-dredging.

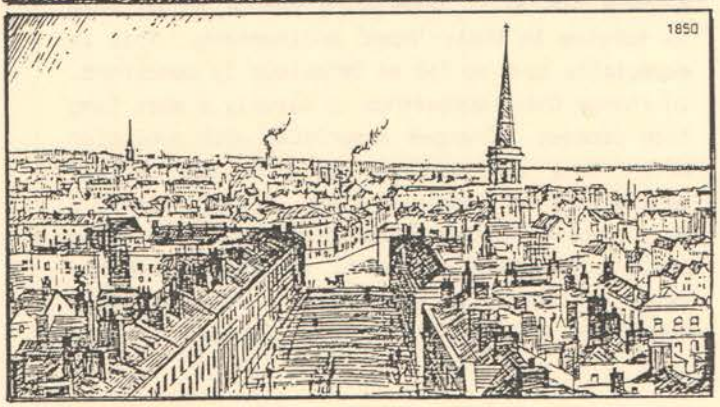




HOW CAN MAN AFFECT AN ENVIRONMENT ?







HOW LIVERPOOL GREW - in many ways the story of this town is an example of why men change an environment. The industrial development of a town causes the whole landscape to be changed.

(a) Farmers use different methods of cultivation, often with chemical controls of various pests.
This kind of farming can create problems for the local wildlife, by changing the balance of their environment.

(b) Farmers are encouraged to make their farms larger, using more and more of the 'natural environment', so the 'home' of various animals is lost to farming.

In this way, the environment of the wildlife is destroyed and their chances of survival reduced.

3. BECAUSE NATURAL RESOURCES ARE FOUND THERE

Often those countries which have large areas of 'natural environments' are amongst the world's poorest. Mostly, the people have small plots of land on which they grow their family's food, and whatever surplus is left over they sell. This is called SUBSISTENCE FARMING. Such countries often lack the money to begin the processes of industrialisation, and claim that their chances of improving the living conditions of their people is very limited. However, in many of these countries, raw materials, which are used by the manufacturing industries of the West, have helped to provide them with an income. In some cases these raw materials have been found in remote and wild areas and then development has meant damage to the environment - and to the wildlife. The kinds of development which are often needed are: townships for the people, communication and transport systems, and also the buildings and machinery of the mines and quarries.

4. TO IMPROVE THE LIVING STANDARDS OF THE PEOPLE

Some parts of the world are inhospitable places, where people manage to survive with only very considerable effort. The hardships they may encounter could be physical (the climate, or surroundings), economic (not being able to grow enough food to maintain their families), or political.

So, if Man has the will to change the balance(s) of nature, how does he go about achieving this change?

These are likely to be the main ways:

1. Through physically changing how a landscape looks or is sculptured. By physically removing the established landscape, often the creatures which live within it lose their 'homes', and are lost to that particular environment.

2. Through changing the economy of an area. Once an area may have depended upon forestry for its income but, in an attempt to provide a better income for more of its people, a country may decide to remove the forest and replace it with farms. In this way the forest wildlife would be removed. The tree-living creatures found at Penscynor, for example, may well have been threatened by this kind of development.

3. Through changing the ecology of an area. For example, imagine that a particularly vicious carnivore was set loose in an environment. Within a relatively short period of time, it could have significantly altered the natural balance of the area. One example of this would be the introduction of mink into a typically English landscape.

   During the 19th century there were many examples of where, in the process of exploring a country, 'new' wild animals were set loose in an environment, and the result has been a threat to particular local species. Sometimes these sorts of changes occur by accident.

It is therefore quite apparent that Man may not only have a need to change various environments around the world but also the methods of achieving it. Perhaps never before in the world's history has this been true.

So today we are faced with a problem: we can make changes, but should we do so given that the consequences can have such a serious effect for our world ?

To fully understand the problems environmental change can bring, we need to appreciate just how a 'natural' environment operates.

CHART 2
WHAT DO THEY NEED TO SURVIVE ?

In a country such as ours none of us could live as we do without the help of others.

To keep us alive we each need very many other people to provide a whole variety of services which we as individuals could not provide for ourselves. For example, to grow our food, make our motorbikes or to educate us.

Often ,just how much we each rely upon others in our society is forgotten. But what do you think are the most important areas of outside help to affect the way in which YOU live ?

Using this chart, work out the approximate number of people who have been involved in providing the se services for you. For every part of the service count one person.
Place the services in the order of importance which you attach to them - make sure you can justify your view.

RANK ORDER	SERVICE	NUMBER TO HELP YOU	WHY IMPORTANT TO YOU
	SCHOOLS		
	SHOPS		
	TRANSPORT		
	COMMUNICATION SYSTEMS		
	WATER		
	FUEL		

	FOOD		
	MONEY		
	CLOTHING		
	(A) _____		
	(B) _____		

a). If we had not developed our society in this way,so that everyone contributes something to each others way-of-life,would we be able to continue life as we know it ? YES/NO

b). During the last twenty four hours make a list of ALL the people who have provided some kind of service for you.

c). Describe how much more difficult your life would have been without these people.

d). Pick just one of these services, and fully describe what other action YOU would have had to take, without this particular service.

HOW DOES A NATURAL ENVIRONMENT OPERATE?

To understand how the Balance of Nature operates, complete CHART 2.

Imagine a family of four (mother, father and two children) who live in an average sized town. What services do they need in order to maintain the way in which they live? Write your list onto the chart.

(NOTE FOR THE TEACHER: FOR GUIDANCE ON HOW TO HANDLE THIS PARTICULAR PART OF THE TEACHING SYSTEM, REFER TO THE TEACHER'S NOTES ATTACHED.)

You can see that to support just that one family requires not only a large number of people but many different services. Within their environment they were not able to survive alone. If one or more of the services were removed, and the environment was to change as a result, then the way of life for our family would also change. They would need to find alternative ways of providing their lost services - evolution.

The same processes apply to the wildlife of our planet. In an environment there is a balance between the needs of one particular creature and those of other creatures. In this way all groups can survive together.

CHART 3 shows how animals can develop a FOOD CHAIN, and thereby increase their chances of survival by not competing with every type of animal for food.

Under this sort of system, when one link in the food chain is too strong and has too many of its kind, there is pressure on the amount of food available. Given time, the shortage of food will weaken the strong link and bring it back into balance. Our wildlife has survived in this way for millions of years.

On the other hand, if one link is removed from the food chain, it can have a disastrous effect upon the other links in the chain. Perhaps if their own food source is removed from the chain, then they in turn will be in danger. Then their predators will also be threatened.

The world is covered by a variety of different kinds of environment, each having developed within it a balanced system of wildlife. These are 5 of these environments:

1. Swamps

Some plants and animals live in areas which are always surrounded by water. Each has developed features to allow it to live successfully.

Some plants live with their roots in the mud at the edge of a river or lake, or in a swamp. Their roots take in oxygen from the water. Other plants float on the water surface with their roots anchored in the mud at the bottom.

The wildlife which lives in swamps has adapted to the wet and muddy conditions. Many of the birds, such as flamingos, have feet which are a special shape and long legs for wading. Their beaks are shaped so that they can dig in the mud or act as a filter in the water as they search for food.

Many of the animals are reptiles and amphibians. They have special skin which allows them to live in or out of the water, such as alligators, crocodiles, toads and frogs, and they feed on insects, fish and small creatures. The amphibians can only stay on land for a short time, otherwise they will dry out and die.

2. Tropical Forests

There are tropical rain forests in South America, Africa, Asia, North East Australia and on some islands of the Pacific Ocean.

The temperatures are very high all year round in these forests and there is a lot of rain. Because it is always hot and wet, the plants and trees grow very quickly.

In a tropical rain forest, the plants grow on different layers:-

1. The tallest trees are called EMERGENTS and grow up to 40m above all the other trees.

2. Most of the trees grow in the CANOPY layer which makes a roof over the rain forest. The leaves and branches of the trees touch each other, and very little light gets through.

3. The next layer is made up of smaller trees which grow up towards the light.

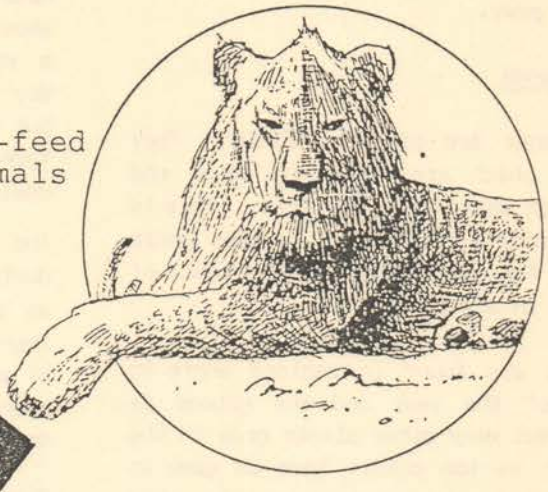
4. As so little light is able to get through the canopy layer, few plants actually grow on the forest floor except for some ferns and shrubs.

The animals and birds which live in a tropical rain forest have developed special features to suit their life here. Most creatures live in the canopy layer where food is more easily found. Animals such as monkeys are able to move from tree to tree using their arms and legs. Many birds are brightly coloured to attract a mate, while others are coloured so they are camouflaged amongst the trees.

There are hundreds of different species of creatures living in each tree in the rain forest. Every creature is able to find enough food to live and to feed its young.

CHART 3 - An Animal Food Chain

LARGE CARNIVORE -feed on the small mammals

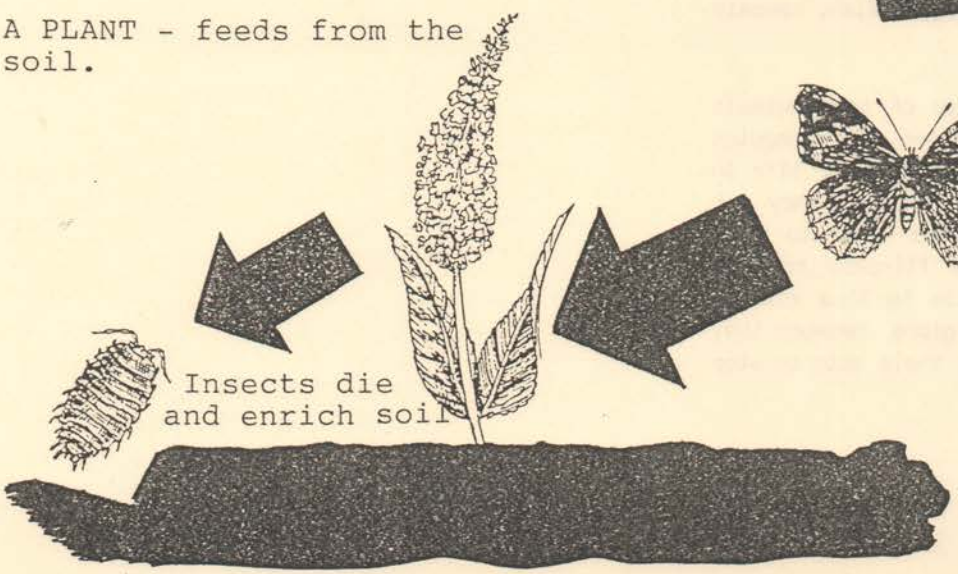


SMALL MAMMALS - feed on the birds.

BIRDS - feed on the insects.

INSECTS - feed from the plants, and help to pollinate them.

A PLANT - feeds from the soil.



Insects die and enrich soil

Some insects even eat the bark of trees. These insects are eaten by birds and small mammals, which may then be the prey for larger carnivores, such as jaguars and birds of prey.

3. Coniferous Woodlands

Trees which have cones are called CONIFERS. They have special leaves which are small and tough and stop the loss of much water from the tree. This is important because conifers often grow in areas where the ground is frozen for many months, so the roots of the tree cannot take in any water.

Coniferous woodlands are found in regions where it is cold for most of the year and the ground is covered with snow. Not many other plants grow in the woodlands because it is too cold. Some do grow in the summer months, but die as soon as the cold weather arrives.

The animals which live in the coniferous woodlands are able to live in the cold. Some hibernate during this time, when their food is hidden under the snow. Some animals will collect seeds and pine cones and store them to eat when food is scarce. Several species of birds of prey live in coniferous forests. They eat the small animals such as rabbits and squirrels which are also searching for food.

4. The Sea

The sea covers over two thirds of the surface of the world, and is 'home' for millions of living creatures: plants, fish, mammals, birds and reptiles. The temperature of the sea changes around the world - the sea in the Polar regions has ice floating in it, while in the tropical areas it is very warm. The creatures which are found in each environment are different, and the land which meets the sea is also very different.

The same process of food chains which happens on land is also found in the sea. There are some tiny animals which eat plants, which in turn are eaten by fish, which may then be eaten by bigger fish, mammals or birds, and so on.

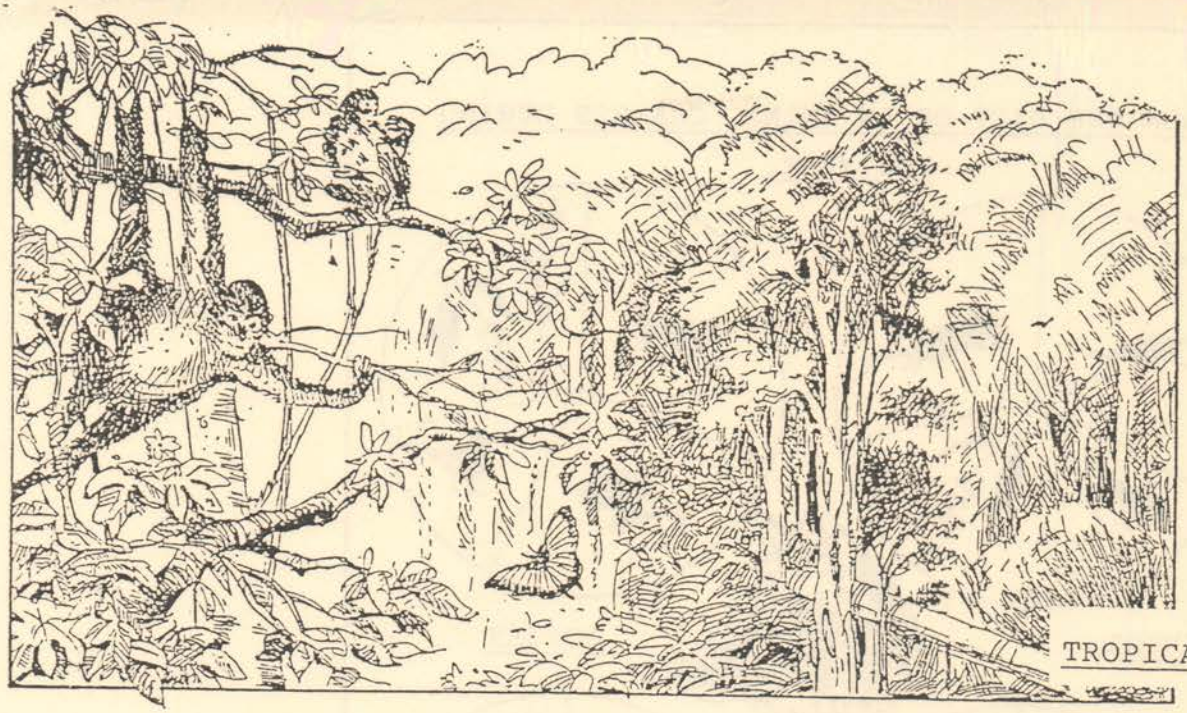
The bodies, skin, fur, or feathers of some animals such as seals, sea lions, walruses and penguins have gradually changed to meet the needs of life in the sea. Penguins are birds but, because they eat fish from the sea, they no longer need to fly. Instead, their wings have become flippers to help them swim quickly. Seals are able to live even in the freezing waters of the Polar regions because they have a layer of fatty tissue under their skin to stop their body losing heat.

5. Grasslands

Tropical grasslands are open plains which are covered with long grass, and a few trees scattered around about. There are two seasons in the grasslands: a wet, rainy season and a dry season. During the dry season the grass does not grow and dies down, but the trees are able to survive because they have a type of special cell in their trunk to hold a great deal of water.

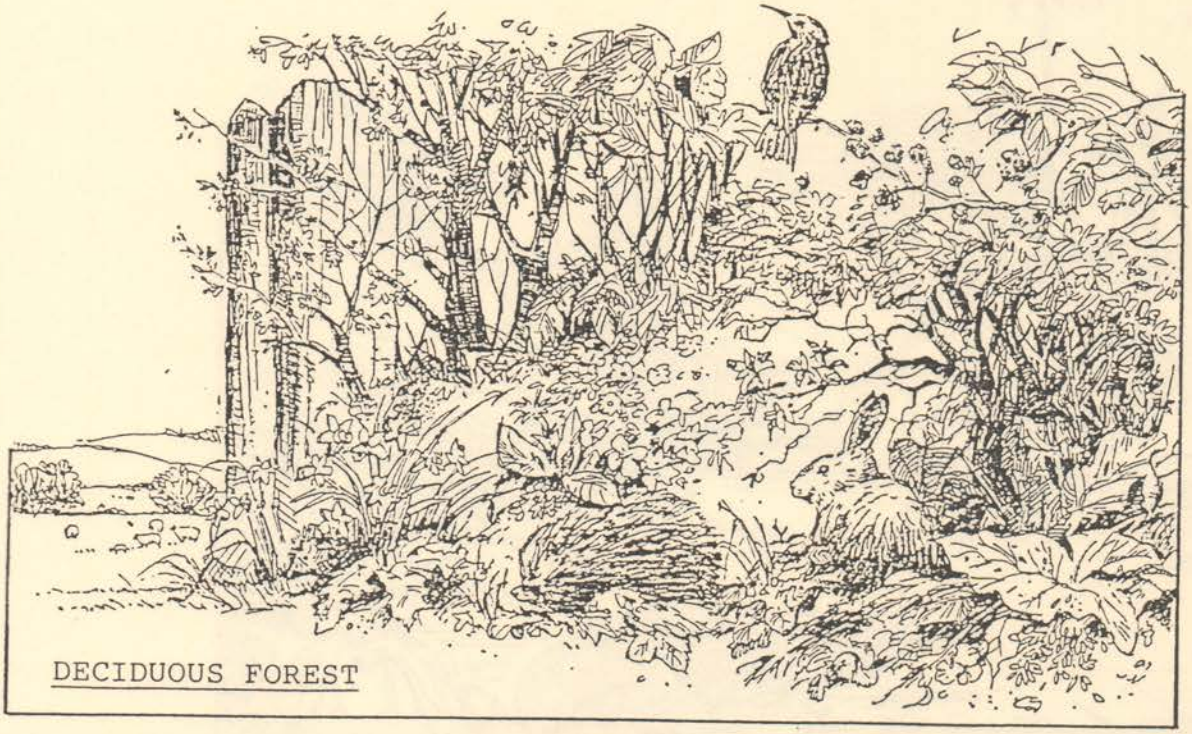
The animals of the grassland also have to survive during these long dry seasons. The herbivores, such as antelope and zebra, eat what grass there is and then undertake long migrations in search of a supply of water. The carnivorous animals, such as cheetahs, hyenas and lions, hunt and kill the plant-eaters and do not need to drink much water.

The grasslands are the home of many small creatures: beetles, grasshoppers, ants and termites. These are eaten both by lizards and birds. Despite the large numbers of plant-eaters, there is little risk of all the grass being eaten in one area because the animals have slightly different feeding habits. For example, zebras eat the top of the grasses, whereas gazelles eat the shoots at the bottom. Scavengers, such as hyenas and vultures, eat dead animals.



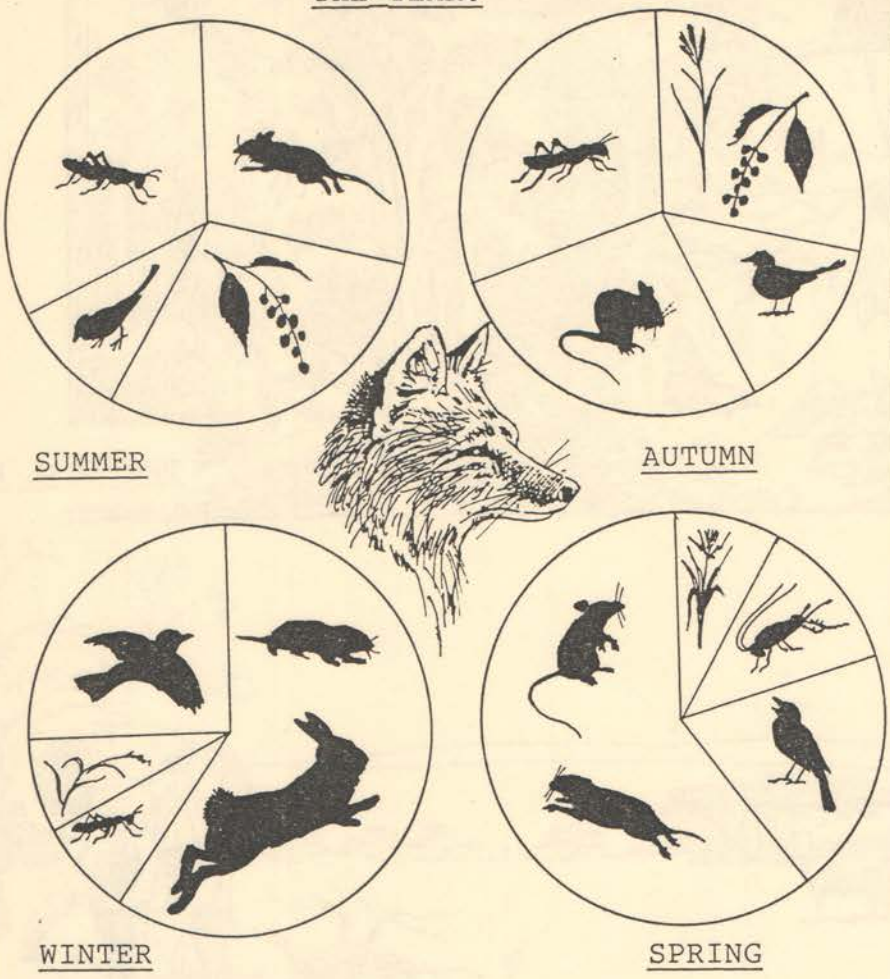
TROPICAL RAIN FOREST

GRASSLAND



DECIDUOUS FOREST

HOW THE DIET OF AN ANIMAL CHANGES DURING THE YEAR.



SECTION 3

HOW IMPORTANT ARE PLANTS IN THIS BALANCE OF NATURE?

For there to be a true balance of nature, both the plants and the creatures have to be in balance. The plants provide food and shelter for much of the local wildlife.

So, how do the plants of an area develop?

Over hundreds of millions of years, more than 400,000 different kinds of plants have evolved. Some of them are small and simple plants, such as lichens, algae, mosses and fungi; others are much larger, including the giant redwood trees of California which grow to more than 110 metres - the largest living things on Earth.

At the time when plants spread out of the sea and on to land the environment was very different from that of today. The soil had no mineral salts or dead materials in it and there was little oxygen in the air to protect the plants from the ultra-violet rays of the sun. At first, plants grew along the banks of rivers and lakes because the soil was wet and gave them food. They were still simple plants with stems but no leaves, but gradually leaves began to appear, and plants such as mosses, ferns and horsetails grew.

About 400 million years ago the climate of the Earth was hot and damp, and the ferns and horsetails grew into large tree-like plants. Slowly the climate became even warmer and drier; these trees then died out. None of the plants so far had grown flowers ,but 130 million years ago the first flowering plants evolved.

A plant's survival in an area depends upon 3 important things:

1. Water

   Water is important for a plant, so plants have evolved in different climates to make the best advantage of the available water. For example, ferns grow best where the soil is damp, whereas others can survive in desert conditions.

2. Temperature

   Throughout the world there are great differences in temperature - from place to place, from month to month, and even from different parts of the day.

   To survive, plants have to adjust to these changes of temperature.

3. Soil

   Soil is important to a plant because it provides food. However, not all soils are the same.

   The amount of dead plant and animal materials in the soil (humus) is important because it provides the plant's food. The diagram shows which is the best mixture of humus in a soil.

HOW PLANTS HAVE ADAPTED TO DIFFERENT ENVIRONMENTS

There are 3 main vegetation types growing in the world : FORESTS, GRASSLANDS, and DESERTS.

FORESTS

There are 3 kinds of forest:

(i) Tropical

Tropical forests grow where it is hot and humid, so that a large amount of water vapour is in the air. There are no seasons, temperatures are always high (about 27°C), and there is a high level of rainfall each year (over 200cm). As there are no seasons, plants lose their leaves at different times of the year. One tree may be shedding its leaves, while the one next to it may have flowers or fruits growing.

Most trees in the tropical forest grow in the layer called the CANOPY. The leaves at the top of these trees are so crowded that very little light reaches the ground below.

In the lowest layer, some plants have changed in order to survive. For example, the 'epiphytes' grow on the trunks and branches of trees but cause the trees themselves no harm. Bromelaids have leaves which form hollows so that water and decaying matter can be collected. Orchids store water in their roots and stems and can also take in moisture through 'aerial roots' which hang in the air. Some plants have their roots in the soil but use the trees as support to climb up to the light. Sometimes, these lianas wrap themselves so tightly around the tree that they kill it.

(ii) Deciduous

The forests of countries such as Great Britain are called deciduous forests. Oak, ash, chestnut, beech and elm grow in these northern forests. They lose their leaves in winter to avoid being damaged or killed during the cold weather. As soon as it becomes warm in spring, their buds break open and the new leaves appear.

In summer the plants grow their flowers, fruits and seeds, which fall to the ground to become new plants. By autumn the sap in the tree is cut off from the leaves and the chlorophyll is destroyed, so that the leaves lose their green colouring and turn to red, yellow and brown, before falling to

the ground. These leaves will rot and decay to become minerals in the soil for the tree to use during the next year. Small plants will die down completely and grow again in the spring.

(iii) Coniferous

Coniferous forests are found in areas where the soil is poor, the cold winter is long, and the summer is short. The plants which grow here have changed to the conditions in several ways. The trees are conifers, and are called EVERGREENS because they keep their leaves all through the year. This helps them to capture as much sunlight as possible. Their branches grow down towards the ground so that the snow can easily fall off and not break the branches. The soil is frozen for much of the year, so trees cannot take in water through their roots. Most trees have needle-like leaves with few stomata to stop water being lost through evaporation.

GRASSLANDS

There are 2 sorts of grasslands in the world:

(i) Tropical grasslands which grow in areas where one season has a great deal of rain, followed by a very long, dry season when there may be no rain at all. Most of the plants are long grasses which grow in the rainy season and die in the drought. Few trees can survive in these conditions, and those which do have had to change. For example, the baobab tree has a very thick trunk with spongy cells which can store a large amount of water during the dry season.

(ii) Temperate grasslands are found in areas with little rainfall, warm summers and very cold winters. The growing season is very short, so only grasses and small shrubs survive.

DESERTS

Not all deserts are hot; some are extremely cold, and are called TUNDRA. In both types, there is a serious shortage of water, so few flowering plants are found.

(i) Cold deserts

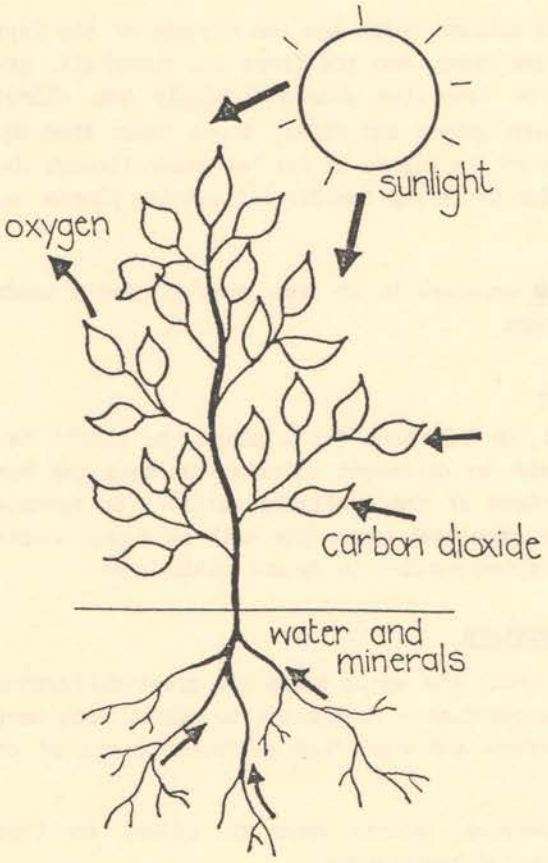
Here, the plants are very short and grow close to the ground, where the air is slightly warmer and they are protected from the freezing winds. They have small, tough leaves to avoid losing water. The soil is frozen and water cannot be taken in through the roots. Many lichens are able to grow in these conditions.

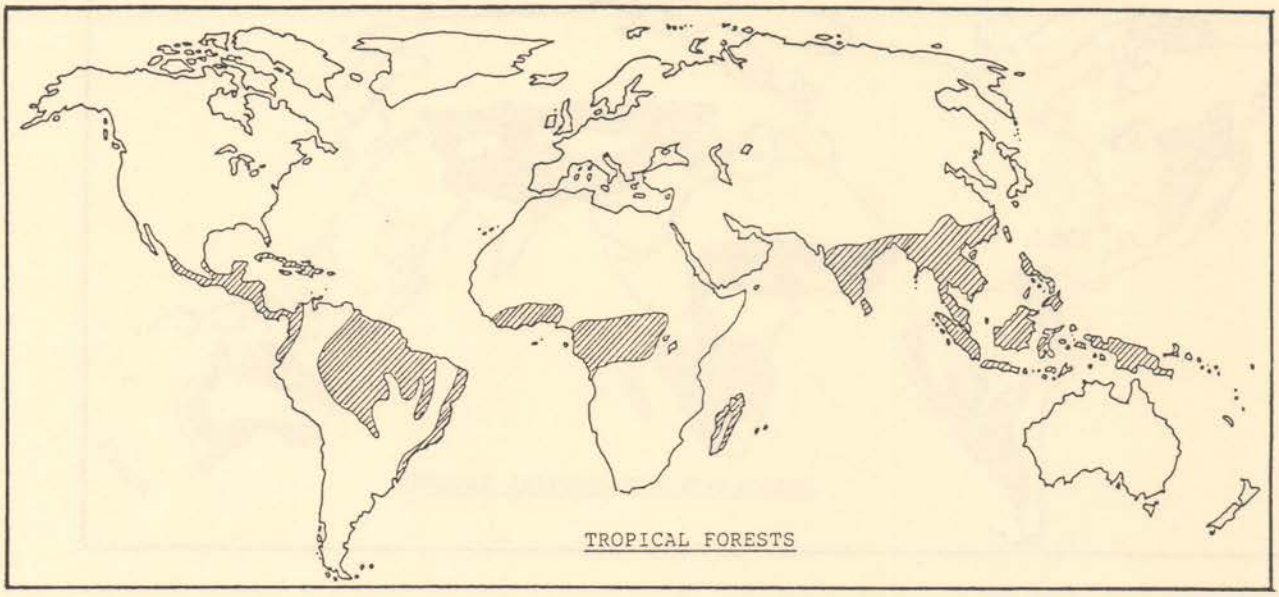
(ii) Hot deserts

The plants which grow in hot deserts have to survive very harsh conditions with little rain and temperatures which may be as high as 58°C during the day and falling to 2°C at night.

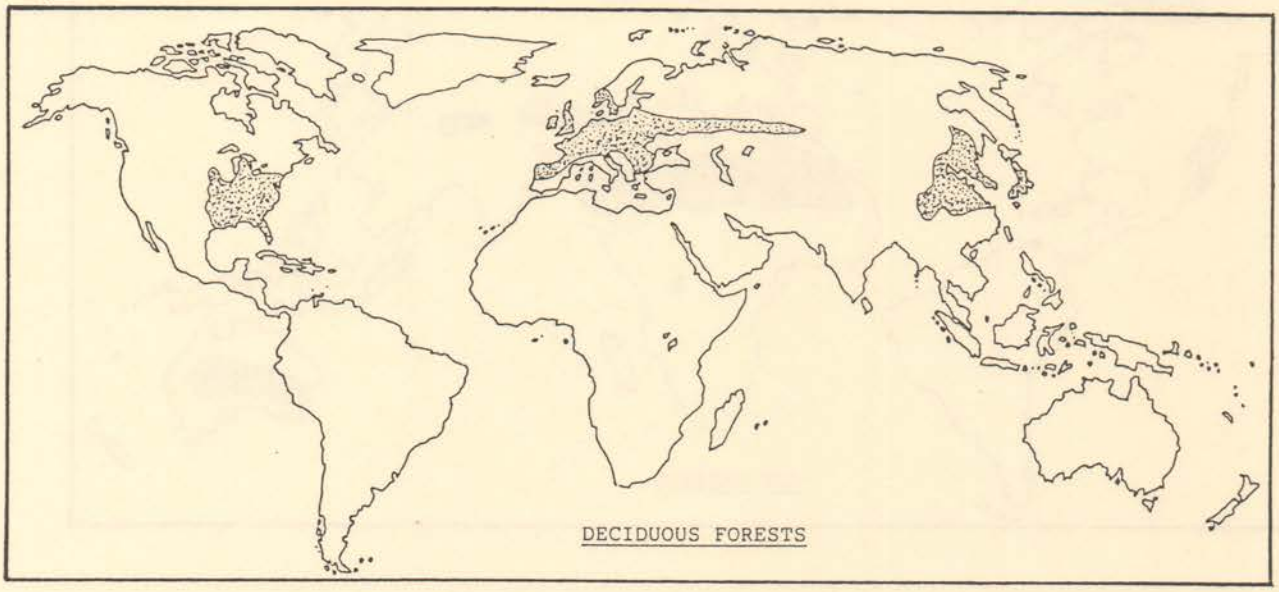
Some plants lie dormant as seeds for many years in the sandy soil, but when enough rain has fallen they grow very quickly. They often have brightly coloured flowers which have a strong smell to attract insects to pollinate them. They produce seeds which are scattered and lie on the ground until the next rain falls.

Many desert plants, such as the cactus, are called SUCCULENTS. They soak up any rain which falls and store it in their stem which is able to expand. Their leaves have become spines to avoid loss of water. These spines are also useful at night when it is very cold: dew forms and falls onto the plant, where it runs down the spines onto the ground and is taken up by the cactus's roots. Roots of cacti do not grow deeply, but spread over a large area just below the surface so that they can collect water.

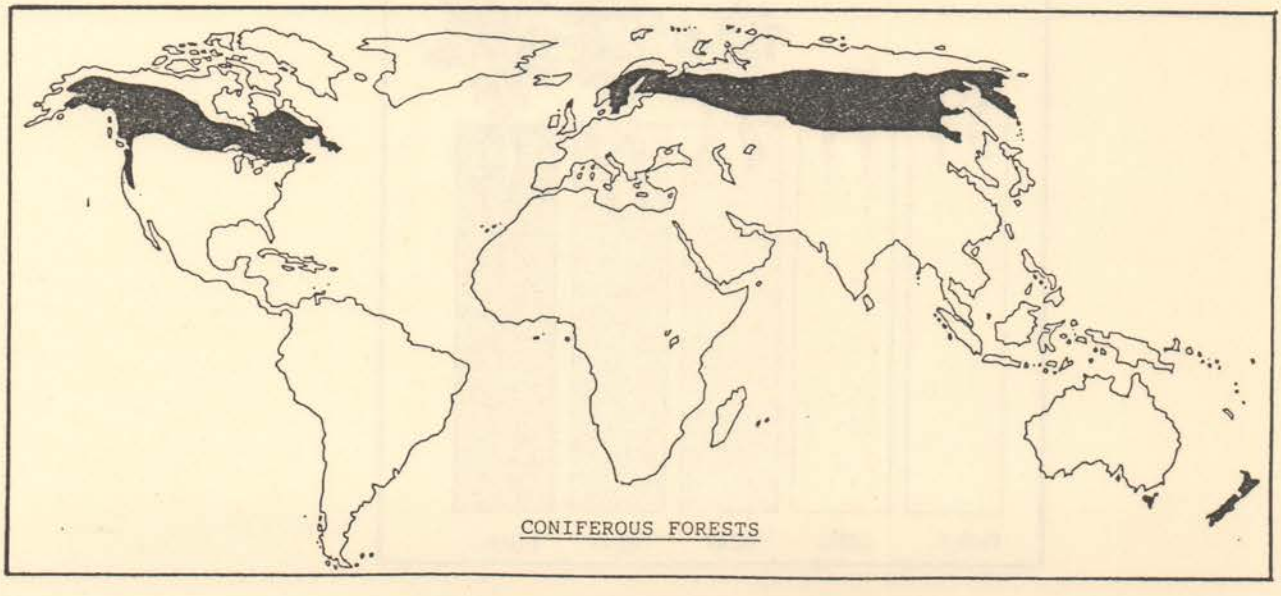




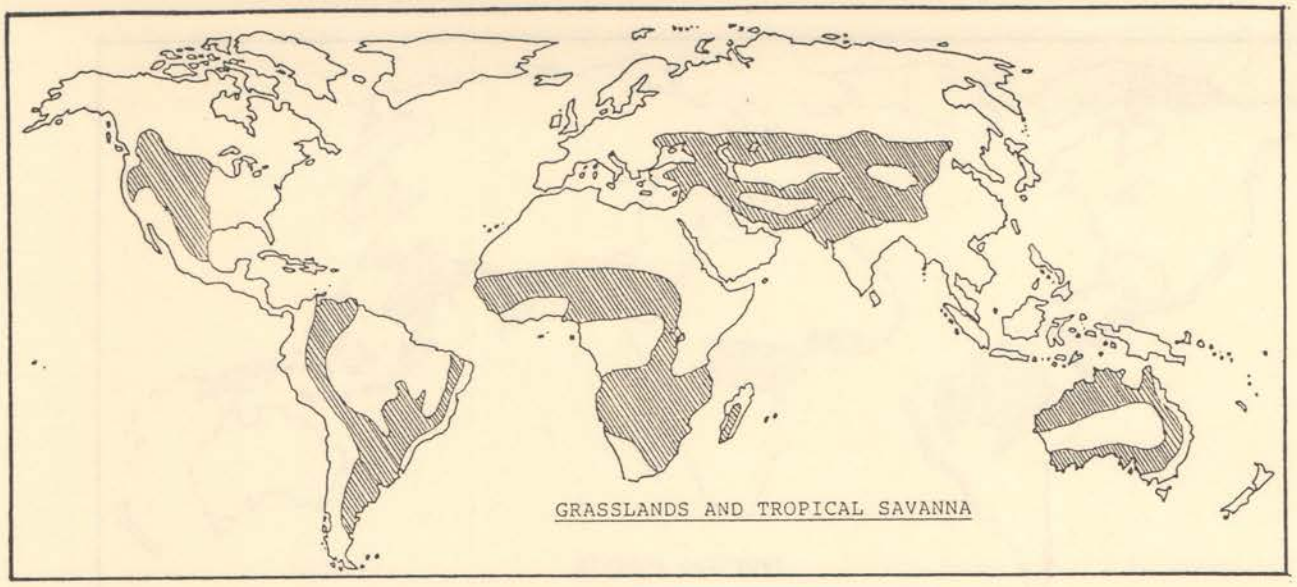
TROPICAL FORESTS



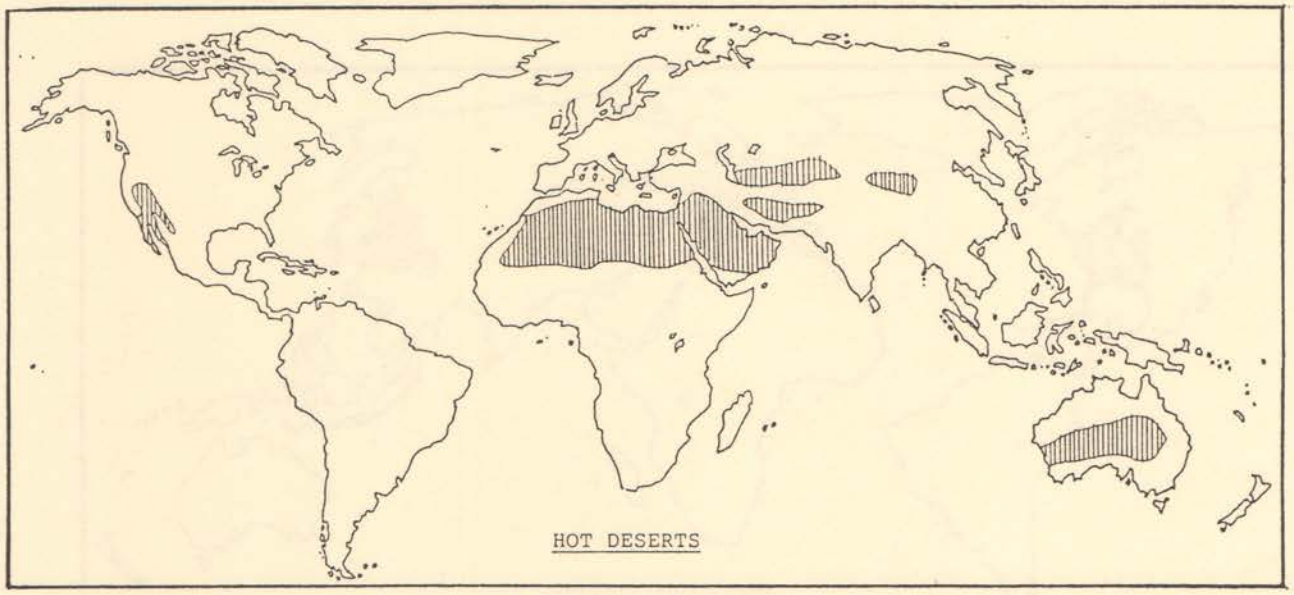
DECIDUOUS FORESTS



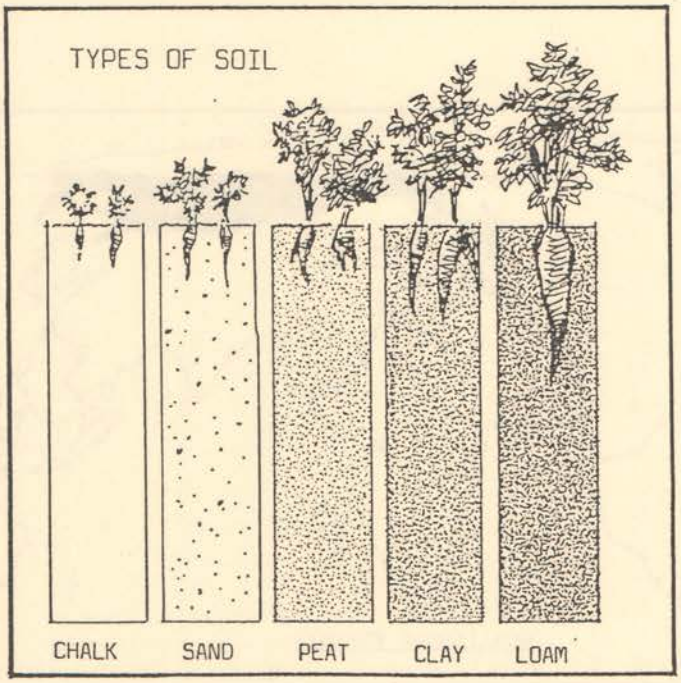
CONIFEROUS FORESTS



GRASSLANDS AND TROPICAL SAVANNA



HOT DESERTS



SECTION 4

HOW DO ANIMALS ADAPT TO THEIR SURROUNDINGS?

To show how animals need to adapt, it is worth looking at one particular environment and one particular group of creatures living within that environment. Because Penscynor is well known for its collection of primates, our choice will be to look at forest areas and the primates which live in them.

CHART 4 shows the evolutionary stages through which primates have passed. During all of that time, these creatures have changed their habits and physical appearance to meet the needs of survival in the place where they live.

There are 2 kinds of primates: the LOWER PRIMATES, such as the bushbaby and lemur, and the HIGHER PRIMATES, such as the chimpanzee and Man (see CHART 5).

To successfully live in the forest, an animal needs two essential qualities:

1. Good eyesight to be able to judge distances and to spot obstacles; and
2. Hands, fingers and tails with which to hold the branches of the trees and to provide balance.

In the forests of the world, there are almost 200 different kinds of primates which have these two qualities.

LEMURS

The RING TAILED LEMUR lives in Madagascar and is at home both in trees and on the ground. To survive, it has developed special characteristics:

On the ground - While this animal is on the ground, its extremely keen sense of smell helps it to survive. The lemur has three sets of scent glands which it uses to produce a warning scent and to mark its territory.

In the trees - When clambering through the roof of the forest, the primate characteristics of keen, forward-looking eyes and its fingered limbs are very useful.
Young ring tailed lemurs use their 'hands' to grasp onto their mothers as they are carried from place to place. Lemurs use this as a good way of protecting their young.
Behind the eye of the ring tailed lemur is a thin layer which can reflect light. This is evidence that at one time, and perhaps until quite recent times, this animal was nocturnal.

Some 50 million years ago, lemurs lived throughout Africa, North America and Europe. During that time they have been replaced in these areas by more advanced primates, who gradually took over control of the lemur's natural environment. They remained isolated on Madagascar when it became an island, and have developed almost unchallenged until recent times.

Other examples of lemurs found on the island are: sifaka, indris, the aye-aye, and the smallest of lemurs which is called the mouse lemur.

Some scientists claim that, being nocturnal, the lower primates survived more easily because they did not have to compete directly with the other primates for food.

MARMOSETS, TAMARINS AND OTHER SOUTH AMERICAN MONKEYS

Just as the lemurs became isolated on their island, so the tamarin(s) and marmoset(s) became isolated in South America.

There are many similarities between lemurs and these South American primates:

(a) They use scent and smell as a way of communicating.

(b) Unlike most other primates, they normally give birth to more than one young at a time - twins are common.

A characteristic of these South American primates is that they have developed a range of facial 'beards' - ear tufts, moustaches, and wig-like headdresses.

Marmosets eat fruit and insects and gnaw at the tree bark for its sap. To help them do this they have developed incisor teeth and very short canine teeth.

Being so small, they move about by running along tree branches, and rather than fingers to hold on to branhces marmosets have claws.

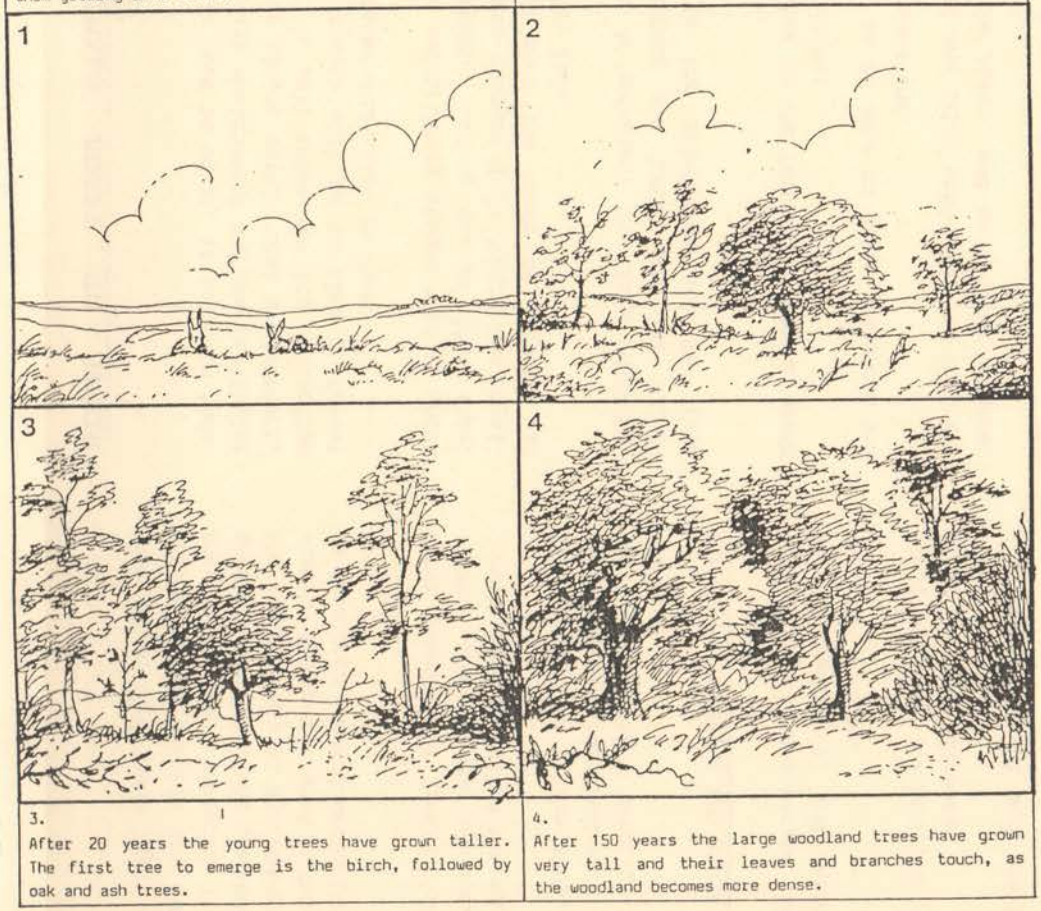
Another unusual characteristic of South American monkeys is their tail, which has become a fifth 'hand'. The hair on the inside of the tail has gradually been replaced by a skin similar to that on the inside of a hand and special muscles at the tip of the tail help it to be used to grasp objects. These tails are so flexible that a spider monkey can hang onto a branch by its tail whilst using its hands to pick food.

The use of their tails is just one way in which these primates have adapted to their 'home' environments - the monkeys of Africa use their tails more for balance. Those primates which live on the forest floor (such as baboons) have tails which serve no

HOW A DECIDUOUS WOOD GROWS

1.
Most areas of bare land would grow into woodland if it was left alone by man and animals. Animals such as rabbits eat the tops of seedlings and stop them growing into trees.

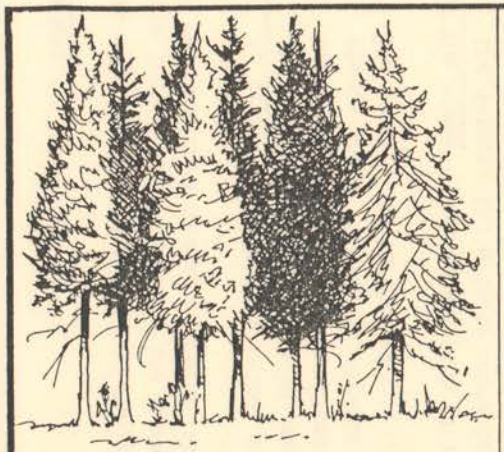
2.
After about 7 years the ungrazed land has grasses, shrubs and small tree growing on it.



3.
After 20 years the young trees have grown taller. The first tree to emerge is the birch, followed by oak and ash trees.

4.
After 150 years the large woodland trees have grown very tall and their leaves and branches touch, as the woodland becomes more dense.

THE DIFFERENT TYPES OF FORESTS



CONIFEROUS FORESTS

Find out 2 things about this kind of forest -

1) _____

_____

_____

2) _____

_____

DECIDUOUS FORESTS

Find out 2 things about this kind of forest -

1) _____

_____

_____

2) _____

_____

_____

RAIN FORESTS

Find out 2 things about this kind of forest -

1) _____

_____

_____

2) _____

_____

_____

real function. Their tails have either become stumps (drill and mandrill) or have become turned up at the end, almost as though they are broken (baboon).

MACAQUES

There are almost 60 different types of macaques throughout the world.

They are often described as the most adaptable and intelligent of all monkeys. They have 3 characteristics which allow them to live both on the ground and in the trees:

1. Fingered hands with which to grasp objects.
2. Keen forward-facing eyes, for observing long distance things and also to look at close range detail.
3. A larger brain than many lower primates. Macaques are able to learn from their environment and change their behaviour to meet new situations. Here are just two examples:

   (a) A group of Japanese macaques had lived in the island's northern mountains for many years, but gradually they began to move into the lower forest areas and out from the snow-covered mountains. In these forests were many warm springs and the macaques now use these as baths. At first only one or two bathed but soon the rest of the group took part, until now it has become a regular part of their behaviour.

   (b) In another part of Japan, scientists were testing the intelligence of macaques and a regular event was to feed them sweet potato. The potato was thrown onto the ground. After a little while, one of the young primates took her potato to a nearby pond and washed it. Again, slowly, others followed her example, until washing the food before eating it became a regular part of their behaviour.

   So, the ability of macaques to adapt to their environment is well developed and can happen quite quickly.

APES

Thirty million years ago, in Africa, one group of lower primates was becoming larger and stronger than its neighbours. Its increasing size caused it problems when moving around in the tops of trees: it could no longer run along the branches, but learned to swing from one to another. This new method of transport brought about these changes in apes:

(a) So that they could swing more easily, their arms became longer.

(b) Tails were no longer needed to give them balance as they scrambled from tree to tree, so over time their tails have disappeared.

(c) The internal arrangement of the animal's body changed from being horizontal (——) under the backbone, to vertical (|) and joined to the backbone.

The ape had evolved. Apes lived in Asia and in Africa, and there are four types: The ORANG UTAN and the GIBBON in Asia, and the GORILLA and CHIMPANZEE in Africa.

ORANGS live in forests, and have two problems to overcome:

(i) They are large and heavy creatures, so moving about in trees can be quite dangerous - especially when thin branches cannot take their weight. One survey of orangs showed that 34% of them had at some time broken a bone, presumably in a fall. They have developed two ways of overcoming this problem: they spend time on the ground, particularly the larger and older males; and they have the habit of clinging to a strong branch and bending it into a 'bridge' to the next tree.

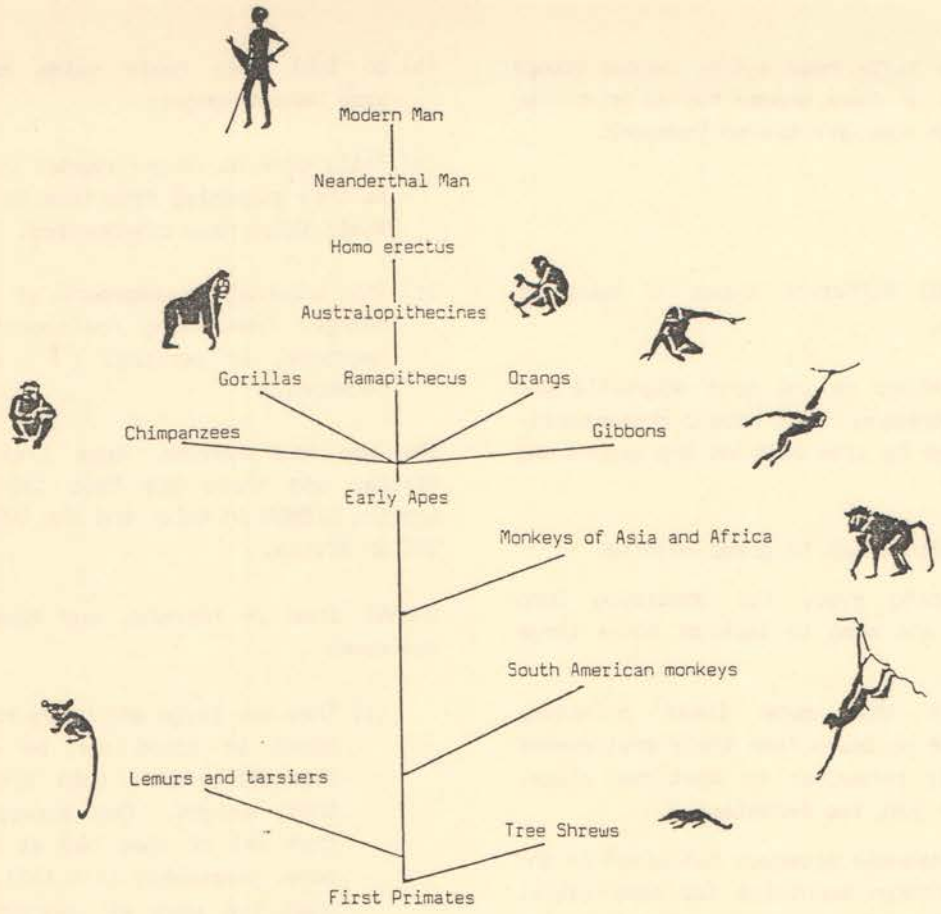
(ii) Orangs are fruit eaters, but in their forest 'homes' fruit bearing trees and shrubs are widely spaced apart.So they will spend many hours wandering through the forests looking for food. Perhaps it is because of this that they live alone, except when the female travels with her young.

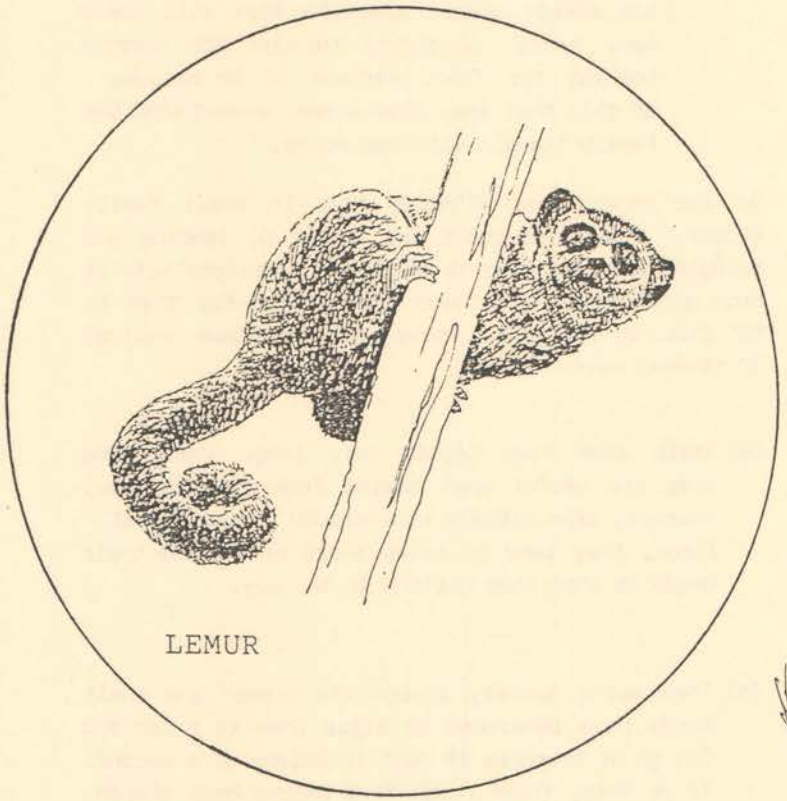
On the other hand, GIBBONS live in small family groups. They move about the forest by leaping and swinging from one tree to another - sometimes with as much as 10 metres between the trees. For them to be able to do this, these primates have evolved in several ways:

(a) Their arms have become very long. These long arms are useful when moving from tree to tree. However, when gibbons move around on the forest floor, they tend to raise their arms above their heads to stop them getting in the way.

(b) They swing quickly around the trees and their hands have developed to allow them to grasp and let go of branches in just fractions of a second. To do this, their hands have become hook shaped and their thumb has become smaller and further down their wrist than that of other apes.

THE EVOLUTION OF PRIMATES





LEMUR

PYGMY MARMOSET

The GORILLA lives in Africa. It is a large ape, weighing as much as 280 kilos.

Gorillas live in families of about 12, led by a male - a silverback.

They eat vegetation from the forest floor, so they have very little need to climb trees. Because its food is so plentiful and easy to collect, a gorilla is usually a gentle creature. In several ways they are like humans:

(a) They have definite stages to their life, passing from childhood to maturity and into old age at about the same age as we do.

(b) They have a 'language' which expresses what they feel. For example, to look directly into a gorilla's eyes is taken as a threat or challenge. But to lower your head and eyes is a friendly gesture.

The way in which the gorilla lives is very closely linked both to his size and to the way in which he collects food. His size means that he has no enemies, and his food is easily obtained, so he can normally lead a quiet and peaceful life.

The other African ape is the CHIMPANZEE. Like the gorilla, chimpanzees live in a family based group with perhaps as many as 50 animals in it.

The diet of this particular ape is much more varied than that of the gorilla who may only feed off 20-30 different kinds of leaves. The chimpanzee eats as many as 200 different leaf types, honey, termites and ants,as well as fruit and small animals.

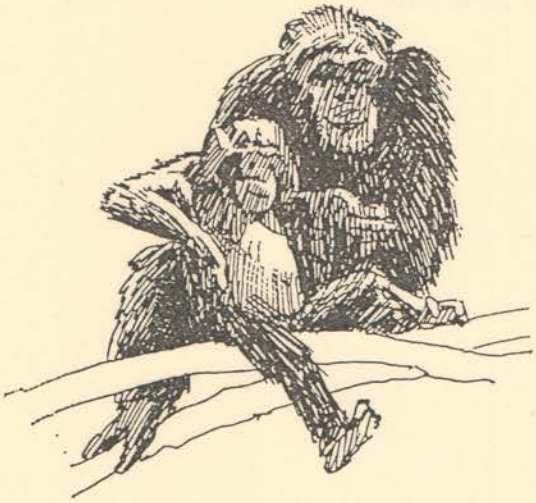
For the first five years of a young chimpanzee's life it will be carried by its mother. Not only does this allow the mother to protect her young, but also the young animal can learn from her how to behave.

The chimpanzees not only use tools, they also make them. For example, when a chimpanzee 'invades' a termite nest it will use a stick to collect the termites. First, the stick will be taken from the tree and broken into the correct length. Then the leaves will be torn off. The stick is poked down into the nest and when it is pulled out it is often covered with soldier termites defending their home. The chimpanzee eats these termites.

So, primates have developed in a number of different ways to meet the needs of the places in which they live. Those which remained in the trees adapted physically to be able to move around the forest roof-tops more easily: longer arms for swinging; tails for balance or for grasping; hands to hold the branches.

Those which came to the forest floor also changed: their larger brains allowed them to develop the skill of making and using tools; their habits often reflected the availability of their food.

These processes of evolution took many millions of years to take place; yet today, the environment in which they live, and on which they depend, is being destroyed at a rapid rate.



CHIMPANZEE

GIBBON

GORILLA

SECTION 5

WHAT CAN HAPPEN WHEN YOU INTERFERE WITH THE 'BALANCE OF NATURE'?

When Victoria became Queen, much of the world was unknown to Europeans. During her reign vast areas of Africa and Asia were 'discovered' and made a part of the British Empire - an empire on which the 'Sun never set'.

There were two main reasons for the Victorians building such a large empire:

1. Many of the raw materials needed for their industry were to be found in these distant countries.

And

2. The Victorians wanted to take their way of life to the people of those countries. It was believed that the native people were 'without culture'.

Expeditions of discovery to the new lands were tough and the men who went on them often needed to be brave.

This is the story of an expedition which could have taken place in 1864.

WHY THE EXPEDITION WAS SET UP

For many years, attempts had been made to find the source of the River Nile and they had all failed.

In 1864, James Sawyer had gained both finance and support for his expedition into central Africa. This would be his third journey to Africa.

James Sawyer knew much about Africa and had been responsible for setting up a trading company called Central Africa Trading. This company brought goods from Africa to be sold in Britain: usually animal furs and skins and the craft work of the local people.

It would be an important part of this most recent expedition to set up trading links with new tribes.

On June 25th, the expedition set sail from London Docks, bound for the African West Coast. The charter given to the expedition had two aims:

1. To explore and map the interior of Central Africa

2. To develop trading links with whatever tribes were encountered.

THE JOURNEY INTO CENTRAL AFRICA

The West Coast of Africa was called "the white man's graveyard" for very good reasons. It was hot and disease ridden.

After a few weeks rest and preparation at the coastal port, James Sawyer and his party set out for the interior. They took with them supplies for their expedition and also trading trinkets.

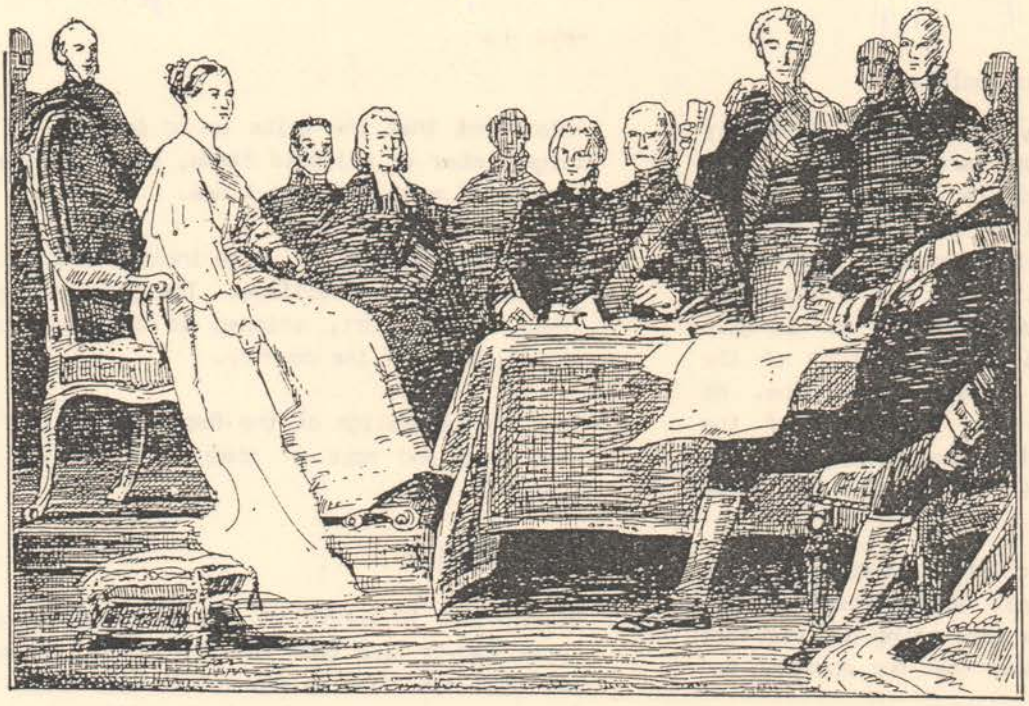
The tropical forests had dense vegetation and progress through the undergrowth was always difficult - even when following the easier route along the river banks. They would only travel about 5 miles each day and sometimes very much less.

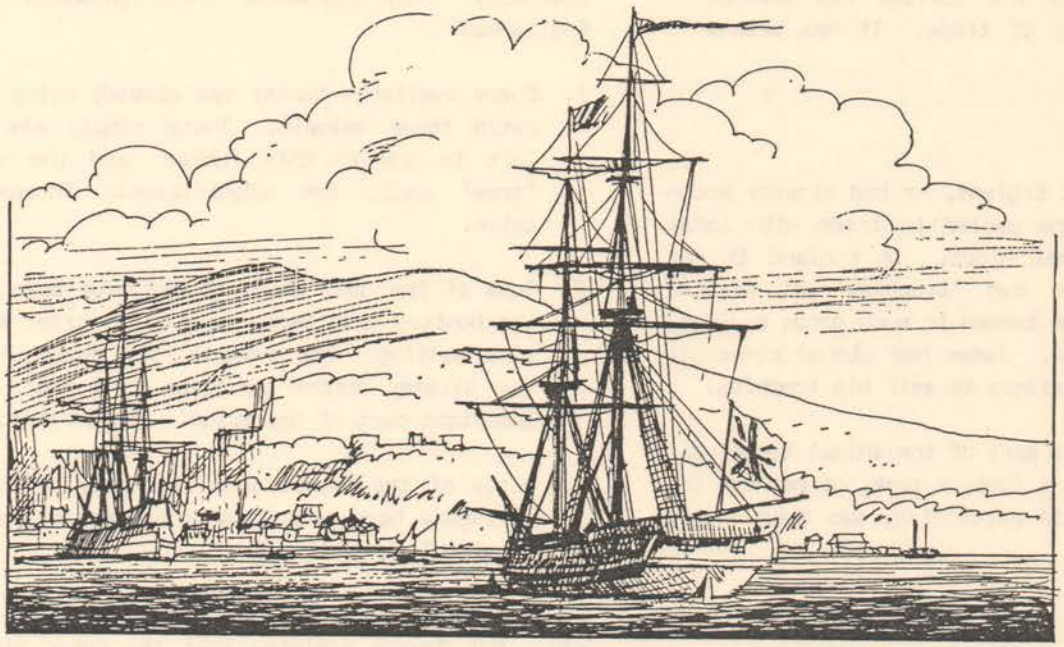
During the tenth week of the expedition Sawyer's party met their first tribe, who were given the name "Backu" because of the threatening sounds they made. At first Sawyer was not welcomed into the tribe's camp, so the English party set up their own tents and waited. It was several days before an invitation came. Nervously, the English explorers walked through the small huts of the village. The villagers were silent. Perhaps they had heard rumours about white men who came to take slaves. For the first time, James Sawyer felt very uneasy.

The meeting with the chief seemed to go well. Despite having to use sign language to communicate, it was clear that the tribesmen were willing to exchange animal hides for the "white men's bangles and beads".

That night, James Sawyer made this entry in his diary:

> "...Today we were led into the very heart of the Backu village. It was like many other villages I have seen throughout Africa.
>
> A small clearing had been made in the forest, and it was a difficult task to maintain that clearing. A stockade of wooden fencing had been erected - it was so feebly put together that I doubt it would have had much effect if some enemy tribe or wild animal desperately wanted to intrude into the village.
>
> Each family had its own hut, or home, which was only high enough to stand in by stooping. Again, the tribe had made use of the materials they had to hand. Hut roofs were made of tree coverings tighly lashed together. The walls were circular, and appeared to be a mixture of mud and dung, baked and cemented hard by the sun.
>
> By the side of many of the small doorways, the women sat carrying out various daily tasks.





This was a very ordered society.

The village was run by a small band of elderly men, something like our own parliament. They were responsible for the decisions which affected the very survival of this tribe. At the head of the council sat the chief. Although it appears that the village is run along democratic lines, you know that this man is all-powerful. He sat silently for much of the discussions, smoking a small wooden pipe. He fixed his gaze upon me. The rest of the council examined with some excitement the presents I had brought with me. But the chief remained impassive.

After some time, the chief stood up and walked away. It was obviously an important signal, because in no time we were being ushered from the village. I believed that our approach had been rejected.

Later, back in our own camp, we were greeted with the news that the village had decided to accept our offer of trade. It has been a great day."

DECIDING WHAT TO TRADE

When James Sawyer left England, he had already known the sorts of things he wanted to trade with local tribes: furs and animal hides. In England it had become fashionable to own 'trophies' of African wildlife and those who traded in such goods could be sure of making profits. James had signed contracts with several large retailers to sell his trophies.

It was usual for only a part of the animal to be used as the trophy - either a foot, a tusk, or perhaps the hide. Bird plumage, in particular, was much sought after.

HOW THE TRADE BEGAN

Trading with the Backu tribe had several advantages for James Sawyer:

1. Their village was in an area particularly rich in wildlife. Not only were there the forest species but also, within just a few days' march, were the open plains of the savannah. Close by was the area's main animal watering hole.

2. The tribesmen were especially skilled hunters.

3. The Backu used poisoned darts to kill their prey, which meant that the animals were not marked in any way and their value was maintained.

4. The tribe was willing to spend as much time as Sawyer needed to hunt and collect their trophies.

This meant that the tribe would produce not only a large number of saleable items, but that they would also be of many different kinds.

A trading route was set up to include regular collecting visits to the village. The trophies were then taken to the port, shipped to England, and sold in many parts of the country.

Soon the reputation of the Backu prizes was so good that more and more of them were demanded by the traders.

MORE IS NEEDED

Within just 10 months of the trade having started, James Sawyer was back in the Backu village. He met with the council and asked that their hunters increase the number of animals killed by at least 100%. The council said no, such a thing was not possible. They explained three problems to the Englishman:

1. Every available hunter was already being used to catch these animals. There simply was no one left to add to this number and the existing 'army' could not significantly increase its catch.

2. Some of the jobs which should have been done by the hunters were being missed, in order to spend time hunting. For example, the sowing of seeds was already behind schedule and crops are an important part of the tribe's staple diet.

3. Parts of the forest seem strangely quiet. Some villagers have noticed an increase in the number of mice in the village.

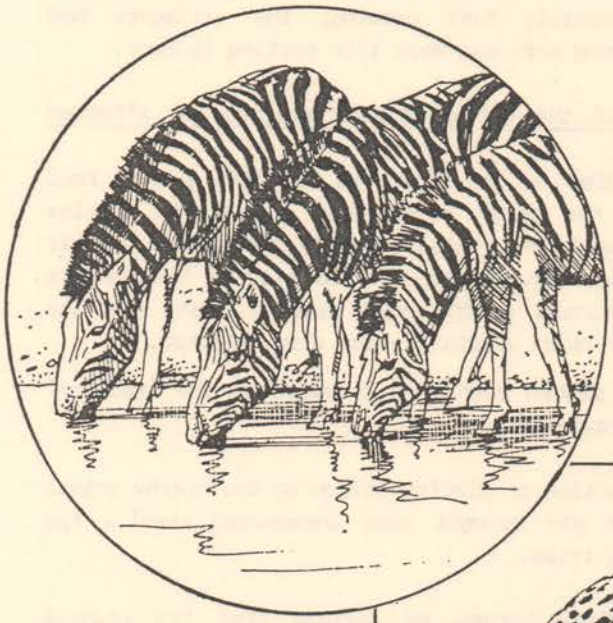
At first it seems that the council will not cooperate. But Sawyer explains that the money the tribe earns from its hunting can be used to buy food.

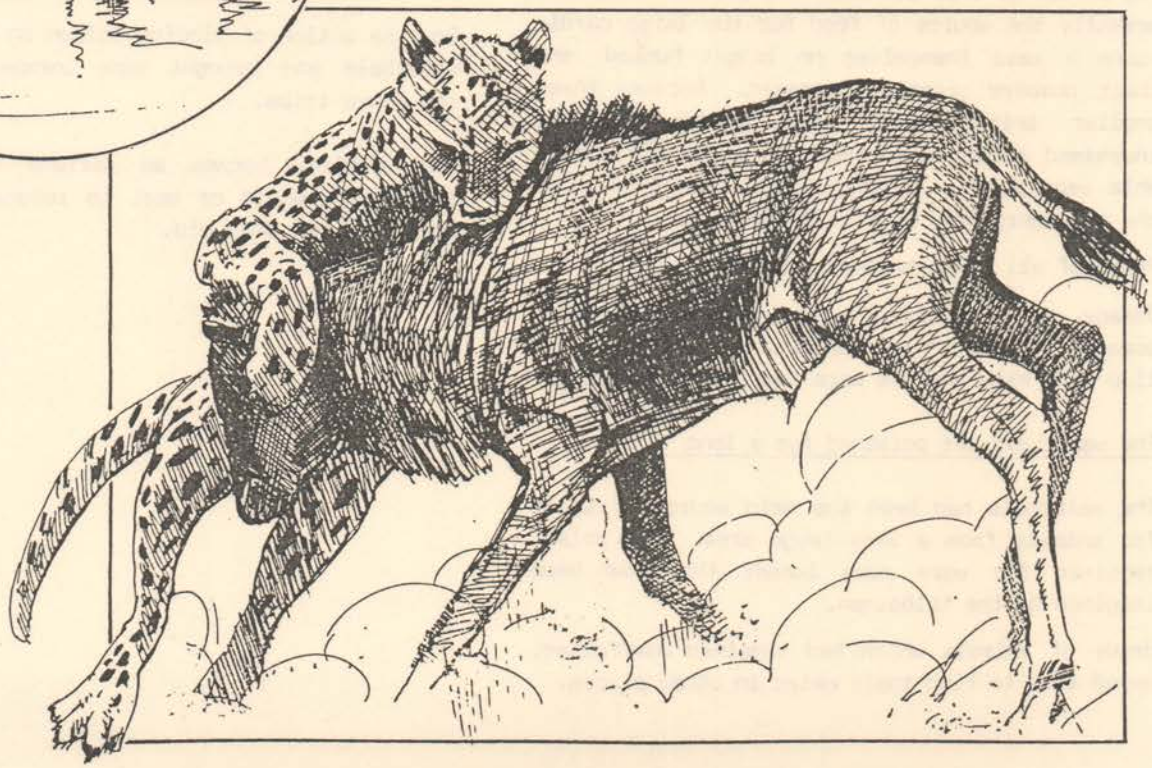
After a lot of discussion, it is finally agreed that some way will be found to catch more animals.

HOW TO KILL MORE ANIMALS

To meet the targets which were set by James Sawyer, the tribesmen had to work harder and for longer hours. Their journeys to catch the animals also covered greater distances. After a short time, the size of the catches began to get less again.

Several months later, trouble appeared for the villagers. The food harvest, which had been planted late, did not take place and their stores of grain were almost running out. The increased swarms of mice were eating more and more of these crops. As an alternative, the tribe had planned to buy food,





but they had not got enough money so the food was not available to them.

The problem became worse and worse, until a serious problem of starvation faced the villagers. Something would have to be done. But what?

At a council meeting, it was decided that one solution would be to find a way of killing a large number of animals at one time. How could this be done? Perhaps the answer lay in the nearby waterhole. Each day thousands of animals came to the hole to drink: If the water were poisoned, every animal which drank from it would die and could be sold by the tribe to raise money to buy food.

It was not a decision which won everyone's support. Some of the council spoke out against the plan - they feared it would destroy the local wildlife.

However, after a long discussion, it was decided that the water should be poisoned.

THE EFFECTS OF POISONING THE WATERHOLE

As it happened, the plan turned out to be unnecessary because, although it was very late, the village harvest was a bumper one that year. But by then, the poisoning had been done and it had several results for the village:

1. The balance of nature was disturbed

   The animals which could earn the tribesmen the largest amount of money were the big carnivores, such as lions. Therefore these animals were hunted most.

   The effect of this was that the smaller animals - normally the source of food for the large carnivores - were themselves no longer hunted and their numbers greatly increased. Because these smaller animals were often herbivores, the increased number soon began to strip the available vegetation. In particular, the crops which the villagers grew were eaten by mice.

   Pests of all kinds became more common.

   Damage was also done to the balance of nature because the poison was added to the water at the time when many animals were tending their young.

2. The waterhole was poisoned for a long time

   The waterhole had been the main source of water for animals from a very large area. The poison remained for very much longer than had been imagined by the tribesmen.

   Herds of animals which had remained unaffected, moved away to find their water in other places. Again, the balance of nature was upset.

3. The poisoned water spread into the village's own water supply

   The villagers had not known that their own water supply was linked by a series of underground passages to this particular waterhole. Slowly, the poison seeped into the village's supply, and affected the villagers.

   This old water supply had been close to the village and was very convenient. Finding a new source had been difficult and it was some way from the village, which caused problems of collection for the villagers.

4. The vegetation began to spread more quickly than normal

   The large numbers of herbivores soon outstripped the food available, and began to disappear. With fewer of them eating what vegetation remained, plants began to encroach into the cleared farmland. Since vegetation of tropical forests is normally fast growing, the villagers had to spend more and more time cutting it back.

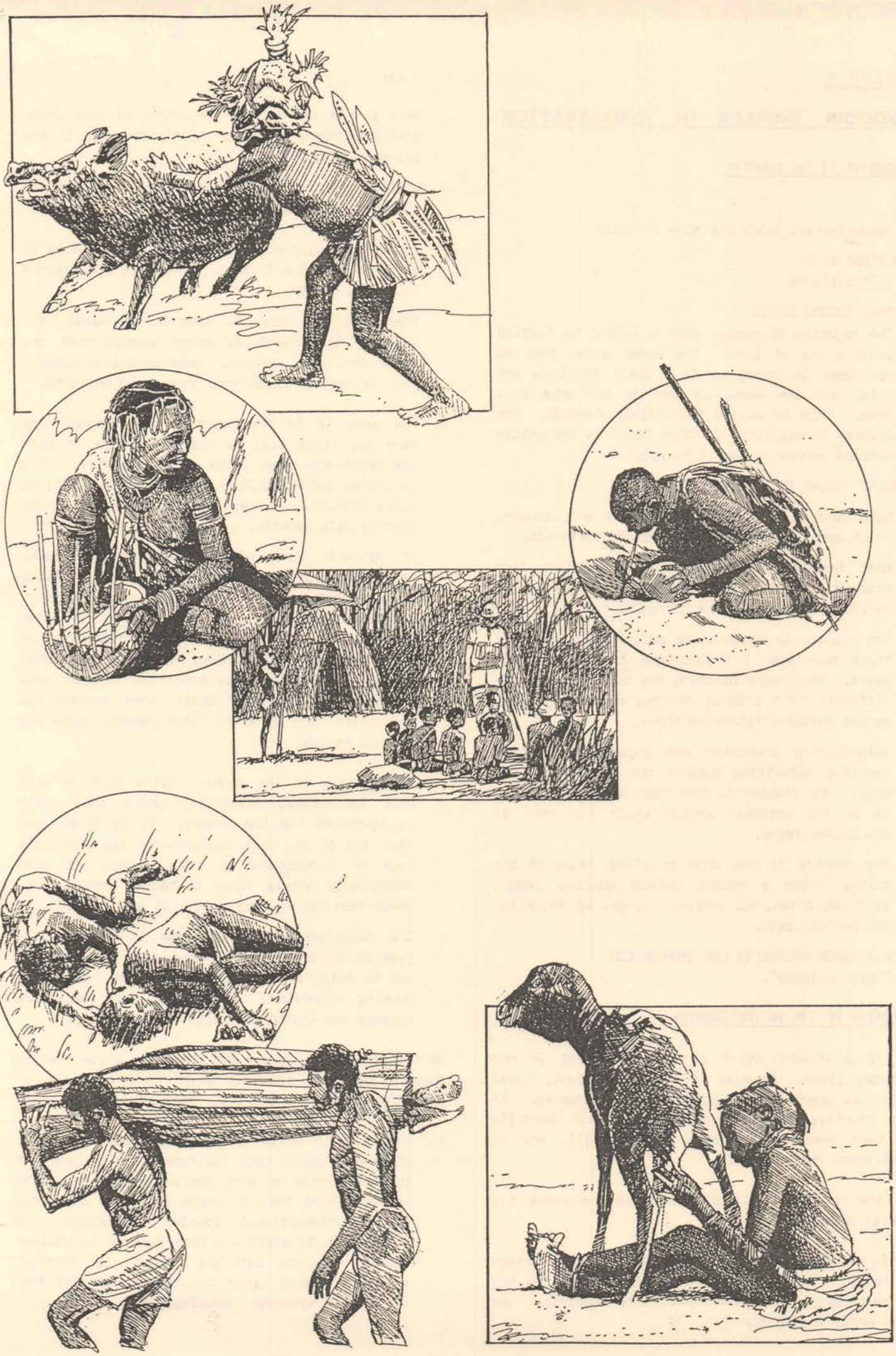
5. One of the village's food sources was affected

   The diet of the villagers had been partly food they had grown themselves and partly berries and meat they collected from the forest. Their action with the poison had reduced the numbers of animals which could provide meat and the berry-laden vegetation was also affected.

   This placed even more pressure on the 'farmers' to provide food.

So, the action of placing poison in the nearby animal waterhole had brought some unexpected results for the Backu tribe.

The problems became so serious that the council decided it would be best to relocate the village - which is what they did.



SECTION 6

A MODERN PROBLEM OF CONSERVATION

BACKGROUND TO THE COUNTRY

AREA

Approximately twice the size of Wales

POPULATION SIZE

3.25 millions

PERSONAL INCOME SOURCE

The majority of people earn a living by farming small plots of land. The crops which they do not need in order to feed their families are sold, and the money is used to buy what they need. This is called SUBSISTENCE FARMING. The country is described as 'Very Poor' by the United Nations survey on "World Poverty".

PROBLEMS FACING THE COUNTRY

1. Long periods of irregular rainfall and drought, which makes planning of agriculture difficult.
2. Most foreign money is earned by selling farm produce : mostly 'luxury' foods. Often, bad harvests result from the irregular rainfall.
3. The country is known to be politically unstable: there have been 2 revolutions in the last six years. This makes planning the country's economy difficult, and reduces chances of foreign companies building factories there.
4. Neighbouring countries are engaged in various guerilla activities against the present Government. The problem is that much of this activity is in the northern region which has most of the better farms.
5. The country is not able to afford many of the things which a recent United Nations' report said would help to improve things, eg education and medical care.

PRESENT KNOWN PROSPECTS FOR IMPROVEMENT

"Very unlikely".

DISCOVERY OF TIN IN THE COUNTRY

Tin is a mineral which is very important in our everyday lives. Because it is so important, great effort is spent trying to locate new sources. In this country, a recent discovery of tin deposits has been described as being "high quality and in significant quantities".

For the country, this discovery is important for several reasons:

(a) It can be sold to other countries to earn foreign money. This money can in turn be used to buy machinery etc. with which to modernise the country's economy.

Many people are already beginning to talk about similar changes to those which took place in the oil-producing countries.

Without such money, the country could not afford to buy such machinery.

(b) It could provide much-needed jobs - especially in an area where the farming is poor and subsistence living is common.

There will not only be jobs in the mines but also in the factories which supply both the mines and their workers. Some estimates suggest that as many as 23,000 new jobs could be found.

(c) The area is in the heart of the country so many new roads will be needed to link it with the ports and other parts of the country. This is called INFRASTRUCTURE. Although they will be built primarily to service the mines, the whole country will benefit.

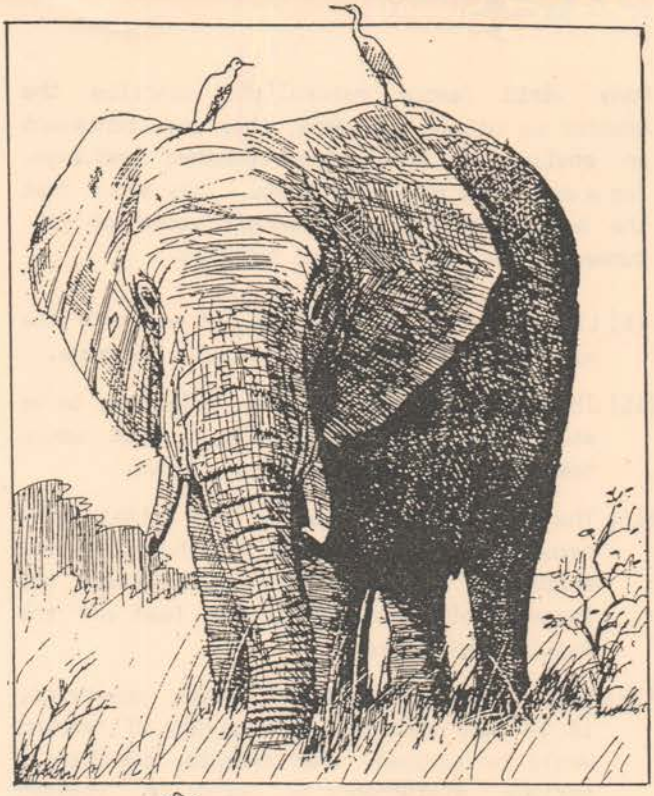
At present most communication between towns is along old muddy trackways. There is no large airport and the port facilities are very poor. The necessary changes would be financed by other countries. Again, without the discovery of tin, none of these things would be possible. The experience of other countries is that once these things have been built they attract new industries into an area. This country hopes for this to happen.

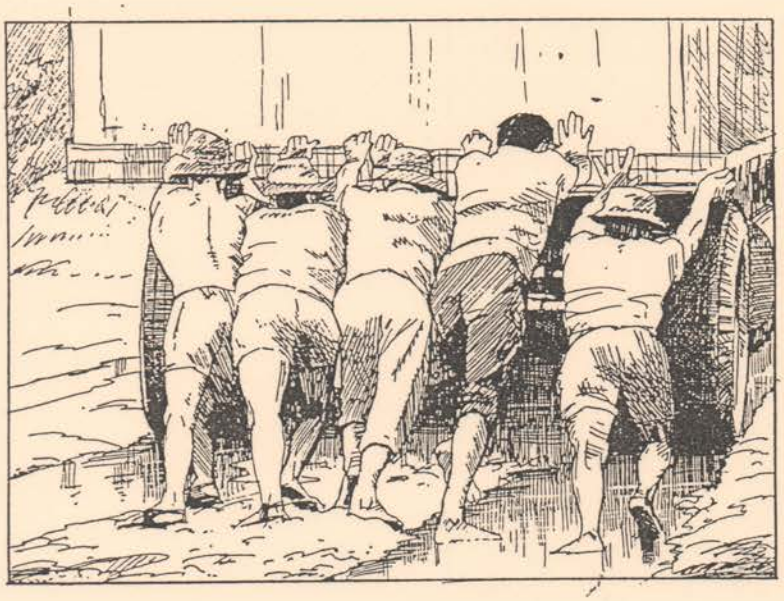
(d) The leaders of the country claim that it will help to provide stability, which they claim is important for the future. It is often said that one of the main reasons for the country's lack of development is that it has not been politically stable since it became independent. There have been 2 revolutions in just 6 years.

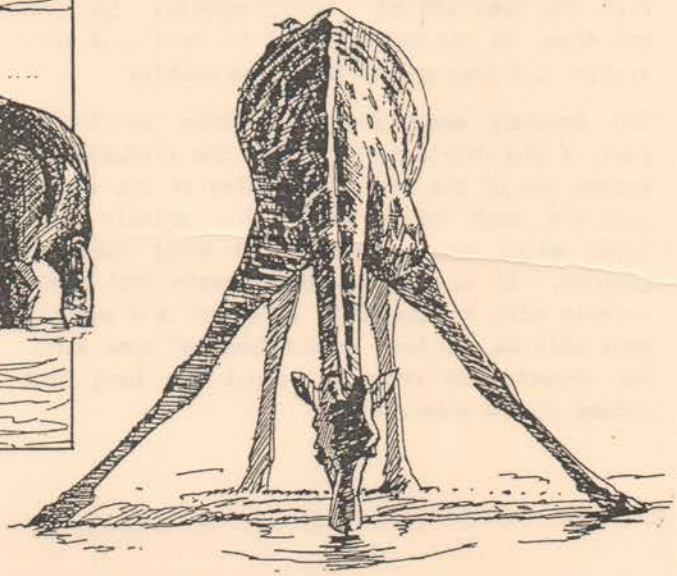
One thing which this has done is to encourage foreign companies not to invest in the country but to build their new factories etc. in neighbouring countries. Obviously, this seriously damages the living standards of the people.

On the other hand, there are those who claim that to develop this tin resource would have a series of bad effects upon the country. They argue that:

(a) The area in which the tin deposits have been discovered would have its farming destroyed. It is also inside an area designated to become the National Game Reserve which is being developed as an international tourist attraction. It was decided to start the Game Reserve to attract foreign tourists into the country; the foreign money it earned could be used to pay for the country's economic development.







Many world famous naturalists describe the Reserve as unique. It does, they say, represent an environment which has remained unchanged for a very long period of time. They argue that the balance of this environment would be disturbed by the mining of tin, because:

(i) Land would be needed to build not only the mine but also the town to service the mine.

(ii) The waste from the industry would have to be stored in huge waste tips, which would take even more land from the reserve.

(iii) The food source of many of the animals (the natural vegetation) would be affected by the activity. In turn, this would affect the large carnivorous animals who feed off the smaller herbivores.

(iv) From the experience of other countries, it is said that the productivity of farming would be reduced. For example, in China a serious disturbance to wildlife created problems which resulted in the farms being overrun by pests: mice ate the crops.

So, the environmental disadvantages are said to be severe.

(b) The location of the mine is very close to the breeding grounds of many different species. It is feared that this will affect the chances of particular animals breeding successfully. There are already several animals which are threatened with extinction in this area.

The opportunity to move the location of this breeding ground, and protect the animals, is nil.

Some naturalists claim that this is the most serious drawback of the plan.

(c) The area will be serviced by a new road network which will be something like British dual carriageways. They will link the area with both the ports and the capital at Rumtali.

The roads are necessary to move the tin out from the area and to bring supplies in. At one time, it had been planned to develop a rail system but this proved to be too costly.

The problem associated with this particular part of the development is that the roadways cut across one of the migration routes of one of the centre's best known apes. The animals move 1,500 miles across country to their breeding grounds. It is said by some experts that these animals will be seriously affected, and perhaps many will be involved in accidents of some kind. The experts are concerned about the long term future of the antelope.

(d) There are some people who claim that this development will seriously damage the community way of life of local people. They are nomads, roaming from place to place eking out a living where they can.

To become workers in the mine will be a totally new way of life for them, with perhaps serious drawbacks to it. The example of the Eskimos is often used to illustrate the point.

It is clear, therefore, that this development represents a combination of advantages and disadvantages. The problem is to strike the right balance.