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NATURE STUDY

PLANTS AND ANIMALS OF NEW ZEALAND

by

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WELLINGTON, NEW ZEALAND

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PLANTS AND ANIMALS

The surface of the earth, the sea and the air are occupied by very many kinds of living beings. This vast array includes an amazing variety of different forms which may, however, fairly easily be arranged into two groups, namely, plants and animals. Plants range in size from bacteria, which are so minute as to be seen only with the aid of a powerful microscope, to giant trees like the big trees of California, the eucalypt of Australia and the kauri of New Zealand. In animals, as in plants, there is a very wide range in variety and in size. The extremes are the simple one-celled animals like amoeba and the blue whale of the Southern Ocean, the largest animal that has ever lived.

Of those we see around us we can easily say which is plant and which animal, though we may not always be able to state the differences. The principal features in which plants and animals differ are the following:—

Plants live on inorganic materials such as water and the mineral substances dissolved in it, and gases, especially carbon dioxide, which is found in the air. Plant foods are built up in all parts of the plant.

Animals live on other animals and on plants, while digestion is carried on only in special organs such as the stomach and intestine.

Plants usually are fixed in position and continue growing in an indefinite way throughout their lives. Only a few can move their leaves or flowers which they do on being touched or when the light changes as from day to night.

Nearly all animals are able to move about and they grow into a definite adult form and size. Generally they can move quickly, and many do so when touched or frightened or pursuing their prey.

Plants are able to store quantities of food for future growth. Potatoes, carrots, and seeds contain stores of food.

Animals do not generally store food though some have quantities of fat which is used during the winter. During their winter sleep bears use up the fat in their bodies, while camels, when food is unobtainable, rely for energy on the store of fat in their humps.

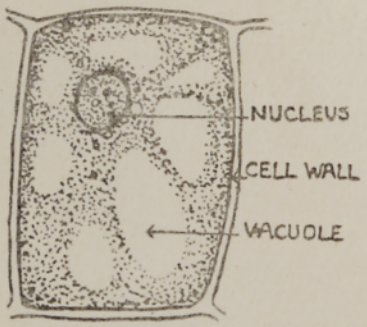
HOW PLANTS ARE MADE UP

The ordinary plants with green leaves are fixed in the ground by means of roots which serve two important purposes. They hold the plant firmly in position, and they absorb water with its dissolved food substances. Roots do not bear leaves or flowers though they may send up shoots which bear these organs.

Above ground plants have one or more, usually branched, stems. These are more or less woody, are strong and rigid and serve to keep the plant upright so that it may spread its leaves and flowers to the light and air. Stems, like all parts of plants, are composed of little parts called cells, which are tiny specks of living matter, called protoplasm, enclosed in a case called the cell wall. In old wood the cell walls are thick and strong and the protoplasm has disappeared. Water and food materials pass up and down the stems either in long cells or in tubes. Some stems grow underground. The stems of the bracken fern, the tubers of the potato, and bulbs are underground stems, though the main part of bulbs are fleshy leaves surrounding the stem.

Leaves are flattened green organs which display a large amount of plant surface to the light and air. They contain a green substance called chlorophyll which is necessary for the plant to make food from water and carbon dioxide gas.

Besides roots, stems and leaves, plants at certain seasons bear flowers and fruits. These organs are for the



GROWING PLANT CELL

WOOD CELL

A dead cell with thick woody walls

purpose of producing seeds which grow into new plants.

A seed is a young plant, for since the time it was an ovule in the ovary of the flower it has grown a root tip, one or two leaves and the beginnings of a shoot. Often, however, as in the buttercup, the seed contains, besides the embryo or young plant, a store of food. Sometimes, as in peas and beans, the store of food is contained in the seed leaves.

HOW PLANTS FEED

Plants obtain the food they require from inorganic materials. In the leaves and other green parts, substances like starch, oil and sugar are formed. These are made from water which comes from the soil through the roots and stem, and from carbon dioxide gas which enters the plant through minute holes called stomata (singular stoma) in the leaves and green stems. These foods, that is, starch, oil and sugar are composed of only three substances, namely, carbon, hydrogen and oxygen. Such compounds are called carbohydrates. The carbon comes from carbon dioxide which is free in the atmosphere, while hydrogen and oxygen are obtained from water. The first food formed is glucose, a kind of sugar.

STOMA

Opening on under side of leaf

In order to make such foods as starch, oil and sugar, the following conditions are necessary:—

1. The presence of sunlight.
2. The presence of chlorophyll, the green substance in plants.
3. A supply of air containing carbon dioxide.
4. A sufficient amount of water.
5. Certain minerals, such as iron and calcium. These are dissolved in the water obtained from the soil.
6. A favourable temperature.

These are just the conditions which are required for all plant growth.

Plant foods which contain nitrogen (they are called proteins), are made in the plant from sugar and from nitrates, that is, substances containing nitrogen, dissolved in water absorbed from the soil. The soil nitrogen comes from the decay of organic remains. From carbohydrates and foods containing nitrogen all the tissues of plants can be built up.

HOW PLANTS GROW AND BREATHE

Plants can increase in size by using the food that they make and the water that they absorb. These cause the newly formed cells to increase in size and when they reach full size they divide into two, each of which, of course, is half the size of the ordinary cell. These half-sized cells then grow to full size and again divide. This is how both plants and animals grow in size.

For plants to grow there must be (1) a supply of fresh air; (2) a temperature that is favourable, usually warm; (3) a supply of water; and (4) foods manufactured by the plant, that is, carbohydrates and proteins.

Growth can take place only when there is a supply of oxygen, of which there is plenty in the air. The process of absorbing oxygen takes place in every living cell of the plant and is exactly the same as the process of breathing in animals.

A simple way of observing the growth of plants is to get some large seeds such as peas or beans, and supply them with the air, warmth, and water required, by planting them in damp soil. Every few days examine one by breaking the seed coat and seeing how much the little plant within has grown.

CHANGES WITH THE SEASONS

Several important changes in the growth of plants correspond with changes in the seasons. Winter, because of the cold, is the season when there is little growth. There are only a few flowers to be seen; but one New Zealand tree, the kohekohe, flowers in the middle of winter; and the puriri flowers all the year round. Ripe fruit is to be seen on several plants well into the winter. Some kinds of trees, the fuchsia, the mountain lacebark and the makomako for instance, lose all or nearly all of their leaves in winter; and some plants, like the mountain tutu, die down to the ground. Many introduced kinds such as oaks, beeches, and sycamores, are leafless in winter. Seeds lie on the ground in winter not germinating because it is too cold.

When the warm weather of spring comes the plants grow more quickly. Seeds germinate, plants that have died down sprout again, shoots grow on trees and shrubs, and the flowers open. In summer the plants continue to flower and to bear fruit and seeds.

As the autumn comes on plants prepare for the winter. Most of them cease flowering and fruiting. As the cold increases growth slows down and stops until the return of warmth in spring. As the weather becomes still colder leaves fall from the trees and several herbaceous mountain plants die down to the ground. Nearly all rest in one way or another until the return of spring.

HOW POLLEN IS CARRIED FROM FLOWER TO FLOWER

In order that the ovule which is found in the ovary of the flower may develop into a seed its egg or female cell must fuse with a male cell brought to it in a grain of pollen. The pollen is deposited on the sticky stigma of the flower and sends down a tube to one of the ovules in the ovary. One of the male cells in the pollen tube fuses with the egg cell which is then said to be fertilised and the ovule will now grow into a seed.

BEE VISITING FLOWER

Pollen is collected on the bee's body and legs

There are two methods by which pollen is carried from flower to flower.

First, pollen may be blown by the wind. Plants which use this way of having their pollen carried usually produce large quantities of dry pollen. Pine trees and grasses are examples of such plants.

Secondly, pollen may be carried by animals. Insects visit flowers for food. Inside many flowers there is found a sweet sugary juice called nectar, and it is this that the insects seek. When sucking up the nectar from the flowers some pollen is sure to stick to the insect's body and so will be carried to another flower, where it may touch the sticky surface of the pistil. Bees carry large quantities of pollen on their legs. Some of this may be transferred from one flower to another as the bees move about seeking nectar. Pollen may be carried from flower to flower by birds. When a bird such as the tui or bellbird is sipping nectar, pollen often sticks to the feathers on the forehead and afterwards comes off when other flowers are visited. The flowers of the flax, kowhai, rata, and fuchsia are visited by nectar-feeding birds.

HOW SEEDS ARE CARRIED

It is an advantage to plants to have their seeds carried to some distance from the parent plant. In this way they can find new spaces in which to grow.

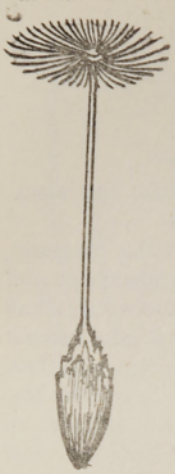
Seeds and fruits containing seeds are carried mainly by means of water, wind, and animals.

Seeds that are carried by water are, of course, light enough to float, and have a coat through which water will not easily soak. Plants that live near rivers often have floating seeds. The seeds of the kowhai will float for a long time without losing their power of germinating; so also will the coconut, which can float from island to island and grow after it has been cast up by the waves. Flax seeds float and so may be distributed by flowing water.

Many seeds, such as those of orchids, are so small and light that they can be carried some distance by wind. Some, like those of dandelions, thistle, and clematis, have little parachutes of fine hairs, while others have on the fruits, vanes which help them to glide to some distance. The akeake, pine and sycamore have such vanes or wings. Ferns do not bear seeds but instead tiny spores which are easily carried by wind.

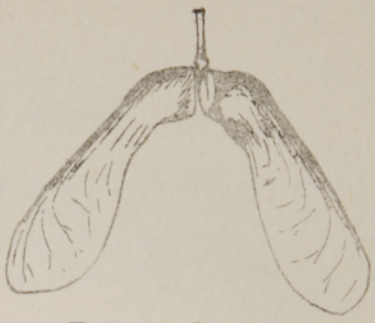
Mammals may carry seeds in their hair, or birds among their feathers. Water birds, such as ducks may carry seeds in mud which clings to their feet. The fruits of the piripiri (bidibidi) and uncinia have little hooks which enable them to cling to animals. The seeds of the tarata and karo are embedded in a sticky substance and thus are often carried about on the feathers of birds. In one New Zealand tree, the parapara, the fruits are so sticky that small birds like silvereyes and fantails may get entangled in them and not be able to free themselves. When fleshy fruits are eaten by birds the seeds usually pass through the body of the bird without losing their power of germinating. Many New Zealand trees and shrubs, for instance, the karamu, mahoe, tawa, puriri and nikau palm have succulent fruits and their seeds are spread about by birds.

Man is a great distributor of seeds. By importing plants and goods packed in straw from other countries he has unintentionally brought in the seeds of weeds which have soon established themselves and spread to other localities. In a similar way the carriage of goods within New Zealand has been the cause of seeds being distributed. Man's domesticated animals, like sheep and cattle, carry seeds sometimes for long distances. Seeds are hurried along the railway tracks by passing trains causing the dust to rise. In this way we have several hundred kinds of weeds spread far and wide throughout New Zealand.

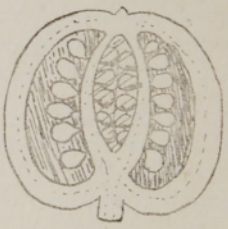


Dandelion

Clematis



Fruit of Sycamore



Fruit of Karo

Winged Fruit
of Ake Ake

Fruiting Head and Single Fruit of
Piripiri

Fruit of Uncinia

DIFFERENT SEEDS

PARTS OF THE FLOWER

The best way in which to learn the parts of a flower is to gather a few kinds of moderate-sized or large flowers and pull off the parts, starting from the outside.

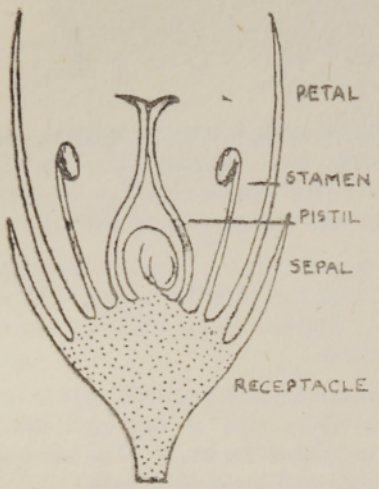
The receptacle is that part of the flower stalk which bears the floral leaves. Often it forms part of the fruit after the flower has withered. Such is the case with strawberries, apples and pears which have fleshy receptacles.

First, there is a circle of green, leaf-like organs called sepals. Together, they form the calyx, which in the flower bud encloses all the other parts. In some flowers, as in the buttercup, the sepals are separate; but in others, as the koromiko, kowhai, and poro-poro, they are joined into a little cup.

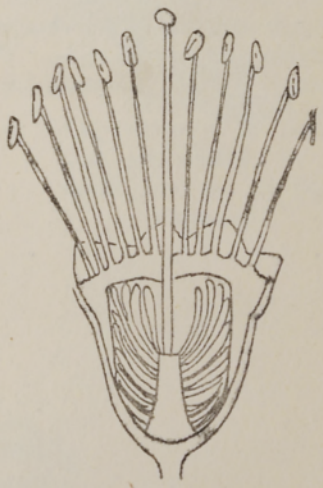
Inside the calyx is the corolla, the separate parts of which are called petals. The corolla nearly always is coloured. The petals may be separate, as in the buttercup, kowhai, and rose, or joined into a tube or funnel as in the koromiko, convolvulus, and snap-dragon.

Inside the corolla are the stamens, sometimes the same in number as the petals, sometimes many more, as in the rata and sweetbriar. Stamens consist of a stalk bearing at the top a yellow organ (blue in fuchsia) called the anther. Pollen grains are formed in the anthers. In the houhere the stamens are joined by their stalks, and in the daisy by their anthers.

The central organ of the flower is within the anthers. It is known as the pistil and its separate parts are called carpels. Each carpel consists of three parts, the ovary, which bears ovules containing the egg-cells, the style or stalk above the ovary, and the stigma at the top of the style. The stigma has a sticky surface on which pollen grains are caught. The carpels may be separate as in the buttercup or joined together as in the koromiko. Sometimes, as in the kowhai and pea, the pistil consists of a single carpel only.



SECTION OF FLOWER



POHUTUKAWA FLOWER

Section of flower of Pohutukawa, showing the petals and stamens on the top of the ovary which is entirely enclosed by the calyx

FRUITS

If pollen has been transferred to the stigma of a flower and fertilisation is effected, that is, the male cells in the pollen have fused with the egg cells in the ovules, then the ovules will develop into seeds, and the ovary itself, with or without some of the surrounding parts, will grow into the fruit. The purpose of the flower, therefore, is to produce the seeds which are contained in the fruit. The purpose of the fruit is to distribute the seeds, for, generally, it is the nature of the fruit, whether fleshy, winged, provided with hooks or able to float, that helps it to be carried to some distance from the plant on which it grew.

A drupe is formed from a single carpel. The ovary wall becomes fleshy outside and hard inside. The plum, cherry, karaka, karamu, and walnut are drupes.

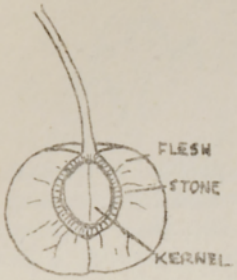
A berry is fleshy right through, and the seeds are scattered about in the pulp. The grape-vine, gooseberry, orange and poroporo bear berries.

In a pome the receptacle becomes fleshy and includes the ovary with its seeds. Apples, pears, and hawthorns are pomes.

Pods are formed from a single ovary which when ripe is dry and splits open to release the seeds. The kowhai, pea, bean and gorse bear pods.

Nuts are dry fruits with the ovary wall very hard. The fruits of the oak, hazel, and beech are nuts.

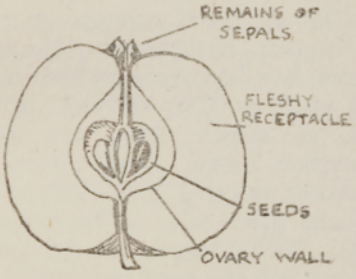
Achenes are like nuts but the ovary wall is not so hard. Buttercups and docks bear achenes. The grains of grasses are like achenes with the ovary wall fused to the seed coat.



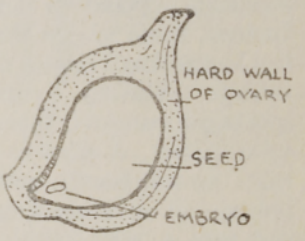
Drupe of Cherry Tree

Karamu Drupe

Cross Section of Gooseberry



Pome of Apple Tree
The fleshy receptacle forms the greater part of this fruit



Achene of Buttercup
The embryo is small and embedded in a large amount of food material

Part of Kowhai Pod Showing Seeds

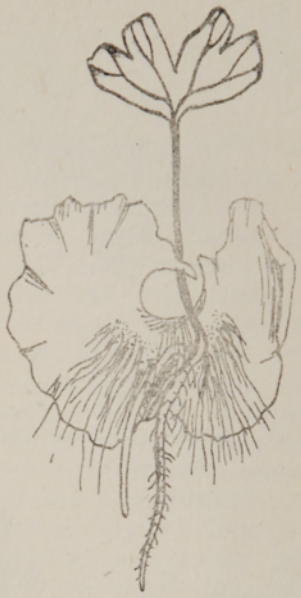
FERNS

Ferns of many kinds are found in large numbers in the New Zealand bush. They are found, too, but in lesser numbers, in most other stations, even including swamps, sea-cliffs, and warm ground near hot springs. They vary in size from tree-ferns, which may be sixty feet in height, to tiny filmy ferns only an inch high. The leaves of ferns usually are divided into fine segments. Ferns do not bear flowers. Instead, there are on the underside of the leaves small brown clusters of very minute stalked capsules called sporangia (singular sporangium) filled with spores. A spore is not a seed but may be compared with a grain of pollen. It does not grow into a fern but into a very small plant with a single heart-shaped leaf. These little plants are mostly less than a quarter of an inch across and bear the male cells and the female or egg-cells from which the fern grows. If we call this little plant a fernlet then we may say that there are two kinds of plants in the life of a fern, namely, a fernlet that produces male cells and egg-cells and a fern that produces spores. The spores of the fern grow into fernlets and the egg-cells of the fernlet, after fertilisation, grow into ferns.

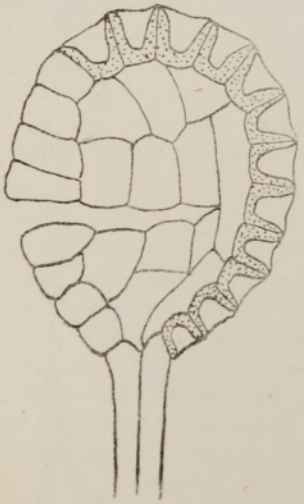
New Zealand is famous for its ferns of which there are over 140 kinds. There are eight species of tree ferns but in two of these the trunks are small and lie along the ground. The most common fern is bracken which forms large areas of fern country. Filmy ferns, of which there are about twenty-five kinds, mostly have the leaves only one cell thick. This is why they can grow only in shady moist places. The lycopods are related to the ferns and like ferns bear spores but not flowers.

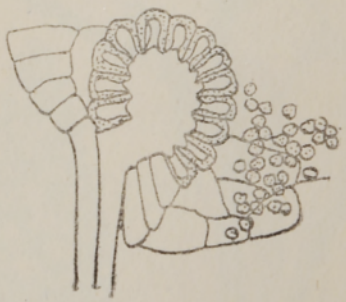
Underside of Fern Leaf

Under surface of spleenwort showing the sporangia and their covers



Fernlet with Fern Growing from it





Fern Sporangium Bursting to Release the Spores

CONIFERS

Most of the plants belonging to this group are called pines, but the true pines have needle-like leaves and woody cones. Most of the New Zealand pines so called have nuts set in a fleshy cup. The conifers are usually trees but two New Zealand species, the alpine totara and the pygmy pine are prostrate shrubs. Conifers do not bear flowers but instead catkins producing the pollen, and cones or fleshy fruits bearing the seeds. A catkin is a cone-like organ consisting of a central stalk and overlapping scales. The stamens which have no stalks are borne on the under side of the scales. Large quantities of dry pollen are produced by these catkins. Cones have a central stalk and wood scales bearing seeds. The miro and kahikatea have fleshy fruits with hard nuts.

POLLEN SCALE OF A PINE CATKIN

PINE CONE

The leaves of pines often are needle-like, as in the Monterey or insignis pine, scale-like as in the rimu and kahikatea, small, flat, and pointed, as in the totara, or thick and flat as in the kauri.

The kauri is a large tree found only in the Auckland Province. It has a large upright trunk and an immense head of branches and foliage. The leaves are flat, oval, and leathery. The cones are globular and about two inches across. The bark of the kauri comes away in flakes and so perching plants are not able to grow on the trunk. The wood of the kauri is straight-grained and easily worked. It is suitable for furniture, buildings, and ship-building. The kauri tree yields a resin known as kauri gum which can be obtained from the tree or dug up in places where kauri forests once grew.

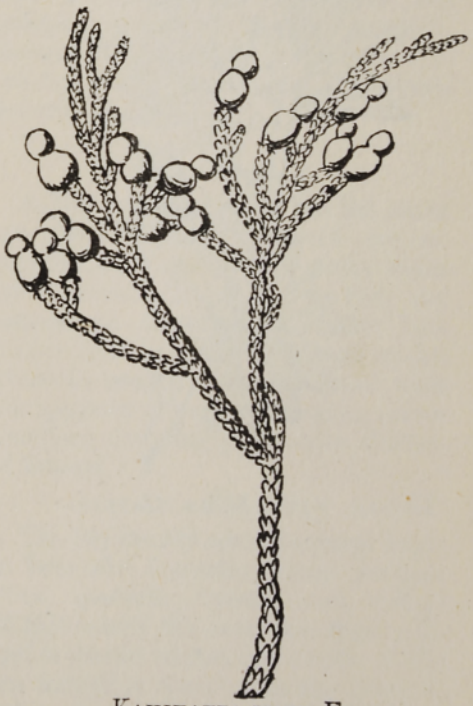
The rimu or red pine is a tall forest tree. The leaves are very small and scale-like and overlap like those of the cypress. Young plants have drooping branches which give them a very pleasing appearance. The fruit is a nut set in a fleshy cup. The timber of the rimu is the principal kind cut in New Zealand. It is used for building and for furniture.

The kahikatea, or white pine, is a large tree growing usually in damp places. The leaves are small and

Seed Scale of Pine

Kauri, Showing Male and Female Cones

Rimu with Fruit



Kahikatea with Fruit

scale-like, and the fruit is a nut set in a red, fleshy cup. The timber of the kahikatea is white and is used mostly for butter-boxes because it is light and does not stain or impart an odour to the butter.

The totara has a stringy bark and small flat leaves ending in a sharp point. The timber is easily worked and resists the weather. It is used for posts and other outside work. It was the principal timber used by the Maoris for canoes and houses, and could easily be carved with stone tools.

Totara with Male Catkins

The matai has small, flat, blunt leaves. The fruit is small, fleshy, and black. The timber is hard and is used for flooring and weather boards.

The miro has small, flat, blunt leaves, like those of the matai but larger. The fruit is red and fleshy and has an odour like turpentine.

The Monterey pine is the common pine that has been introduced into New Zealand. There are large plantations in the Rotorua district and other places. The leaves are needle-like, the catkins oblong and yellow, and the cones conical and woody. The timber is used for buildings and boxes.

Miro with Fruit

FLOWERING PLANTS

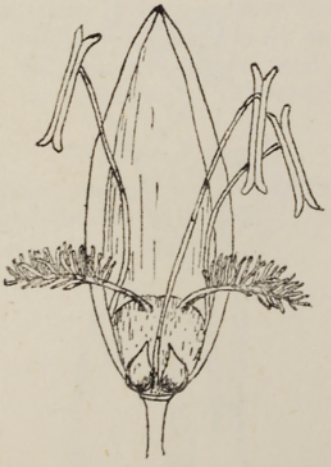
Plants with typical flowers, that is, those which consist of calyx, corolla, stamens, and pistil, though all of these parts are not always present, make up the bulk of the vegetation of the earth.

Flowering plants are classed into two groups, one in which the seeds have a single seed-leaf, and the other in which there are two seed-leaves.

FLOWERING PLANTS WITH ONE SEED-LEAF

Grass Family

Grasses have long, narrow leaves and flowers with chaffy parts in the place of calyx and corolla. The stem is hollow with partitions at the joints. The largest kind of grass in New Zealand is the toetoe. It has flowering stems eight feet or more in height, and in appearance resembles the pampas grass of South America. Several New Zealand grasses are useful for stock. Danthonia is the best-known of these.



Grass Flower

The grass flower has chaffy perianth leaves, anthers that move in the wind, and plumed stigmas

Sedge Family

Sedges are like grasses but the stems are three-angled and there are no partitions. The leaves of many kinds have saw-like edges and so they are known as cutty-grasses. The best known kind is the nigger-head which grows in swamps. It has a trunk with a large head of narrow drooping leaves and long drooping panicles or clusters of flowers.

Lily Family

The lily family contains many kinds of beautiful flowering plants such as lilies, gladioli, freesias and tulips. In this family the ovary has three cells and is placed within the corolla. (The iris family is similar but the ovary is below the corolla.)

New Zealand flax is a large herb with sword-like leaves and large flower-heads up to twelve feet in height. The flowers are reddish and have at the base of the petals some sweet nectar. This forms the food of birds like the tui and bellbird which, when searching for the nectar, carry pollen from one flower to another. A very strong fibre is obtained from the leaves of the New Zealand flax. It is used for making ropes and woolpacks and was used by the Maoris for cloaks and many other purposes.

The cabbage tree has a straight trunk which branches many times and so forms a large head of foliage. The leaves are strap-shaped and borne in clusters at the ends of the branches. The flowers are in large clusters below the leaves.

The supple-jack is a well known climbing plant. It has long cane-like stems which wind round tree trunks and so reach to the tops of high trees where the leaves and flowers can spread out in full daylight. Its fruits are bright-red drupes and are eaten by pigeons.

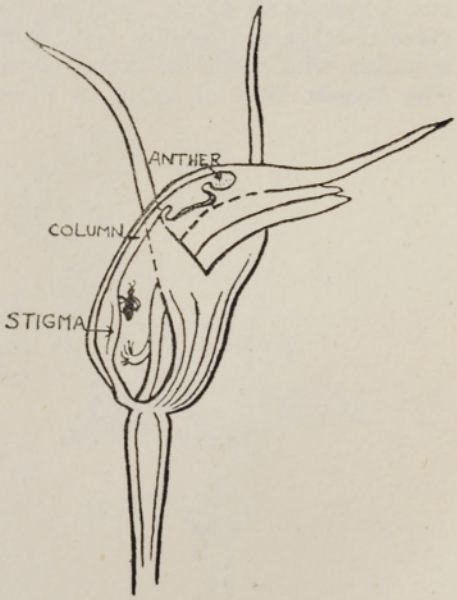
Palm Family

The nikau is the only kind of palm found in New Zealand. It has a straight, unbranched trunk and a large crown of divided leaves, with strap-shaped leaflets. The flowers and fruit are borne in large clusters or panicles below the leaves. They are at first completely enclosed in a sheath but this falls away as the panicle expands. The nikau is found from Hokitika and Banks Peninsula northwards.

Orchid Family

Orchids are herbs with tuberous roots. In most kinds the flowers are so shaped that insects in search of nectar, can crawl into or out of them only by a way that passes the stigma and stamens. In doing so the pollen, which is in sticky masses, usually adheres to the insect and so may be carried to another flower.

Orchids that are common in the New Zealand bush are earina with grass-like leaves and pterostylis, a ground species, with green flowers having one of the petals forming a large hood over the rest of the flower. Earina grows in masses on the trunks and branches of trees.



Orchid

Cross section of orchid Pterostylis showing insect between stigma and anther

FLOWERING PLANTS WITH TWO SEED-LEAVES

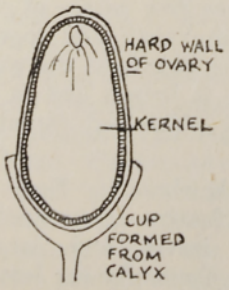
Oak Family

The oak is a British tree. The leaves fall away completely in the autumn. The male flowers are in small catkins and the fruit or acorn is a nut seated in the woody cup-like calyx.

There are five kinds of beech trees native of New Zealand. They are tall forest trees with small leaves and small red flowers. Male flowers (stamens only) and female flowers (pistils only) are found on the same plant. Beeches form forests by themselves in several hilly or mountainous districts. They are named mostly from the colour of the wood or bark, as red beech, black beech, silver beech. The wood is useful for many purposes. Red beech is used mainly for outside work such as posts, bridges, and wharves, and silver beech for furniture.

Willow Family

Poplars, aspens and willows, which are included in this family are not natives of New Zealand.



Acorn or Nut of Oaktree

The weeping willows in New Zealand are said all to be descended from some cuttings taken from the tree planted over Napoleon's tomb in St. Helena. They grow in wet places, especially by the side of streams. The branches are long and drooping and the flowers are in small catkins. Because of densely matted roots willows are useful in checking the washing away of river banks.

Laurel Family

The tawa is a common forest tree throughout New Zealand. Its leaves are lance shaped, thin, and bluish on the underside. The flowers are very small; but the fruit is a large dark-

Clinker Beech

Tawa

Rewarewa

purple drupe about an inch long. The wood is used for tubs and casks and for furniture. The taraire has flowers and fruits like the tawa but the leaves are oblong and are velvety below.

Protea Family

The rewarewa is a tall forest tree with fairly large oblong leaves with saw-like edges. The flowers are crowded in large clusters and the fruits are long brown velvety pods. The wood is hard and prettily variegated. It is used for cabinetware.

Buttercup Family

The members of this family have flowers with all the parts separate and mostly arranged in spirals on the receptacle. There are numerous pistils each resulting in a fruit called an achene. The different kinds of clematis are climbers. The stigma of the ripe fruit forms a feathery tail to the achene and this would cause it to be blown some distance from the parent plant.

There are many kinds of buttercup in New Zealand especially on the mountains. A very large species with white flowers is commonly called the mountain lily. The leaves are circular with the stalk joined on near the middle and so are umbrella-like but the blade is flat with a slight hollow above.

Pea Family

This family includes many kinds of vegetables and garden flowers. The flower has five petals of which two enclose the pistil and together form the keel, a pair form the wings, while the fifth is largest and is called the standard. The pod contains several seeds.

The kowhai is New Zealand's national flower. It is a small tree with pinnate leaves and large yellow flowers. Generally the leaves are lost in winter and the flowers come out

in spring before the new leaves appear. The nectar at the base of the petals is much sought after by the tui and bell-bird, which carry the pollen from flower to flower.

Karo Family

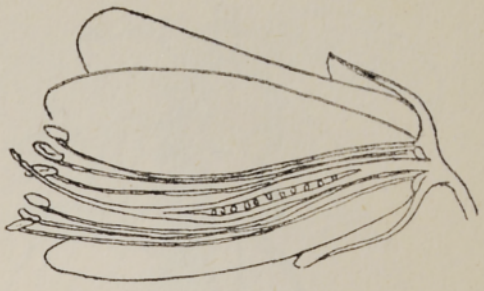
The karo is a small coastal tree of the Auckland district. It is grown as a hedge plant in most parts of New Zealand. The leaves are oblong and covered below with whitish wool. The flowers are dark purple and the capsule large and woody. The seeds are sticky and so are often carried on the feathers of birds.

Kamahi Family

The kamahi is one of the most common trees in New Zealand. It is the principal tree in many upland forests. The young leaves have three leaflets; but the adult leaves are simple. They are coarsely-toothed. The flowers are borne on short upright racemes, that is, there is a central stalk with each flower on a separate short stalk.

Karaka Family

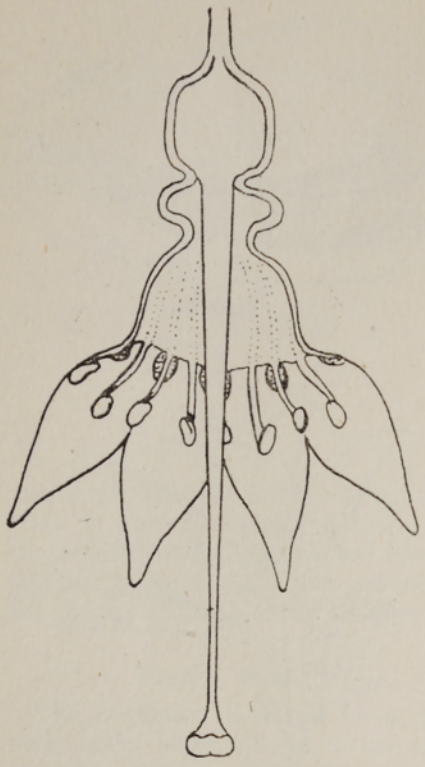
The karaka is a handsome tree usually found near the coast. The leaves are large, oval and shining. The flowers are greenish-white, small and borne in clusters. The fruit is a large yellow drupe. The karaka was planted by the Maoris in their villages because of its edible fruit. The kernel contains a poison, but this disappears during the process of preparing the kernel for food.



Kowhai

Karo

Kamahi



Fuchsia

Fuchsia Family

In the fuchsia flower the ovary is below the petals, of which there are four. The New Zealand fuchsia or kotukutuku is a fairly large tree with papery bark which falls away in thin sheets. The leaves are thin and are white underneath. The sepals are coloured dark purple, the petals are reddish purple and the pollen is blue. The fruit is a berry which is eaten by several kinds of native birds. The style of the flowers of the kotukutuku are of different lengths, some long, some short and some of medium length.

Mahogany Family

The kohekohe is a large tree mostly found near the coast. The leaves are pinnate with large leaflets. The flowers are waxy white and are borne on the stems. They appear in the winter-time. The wood is brown and hence is called New Zealand cedar.

Ivy Family

The ivy family includes several kinds of trees that are found in New Zealand. Like the carrot family the flowers are in umbels, that is, a number of flowers on separate stalks of nearly the same length arise at the same place.

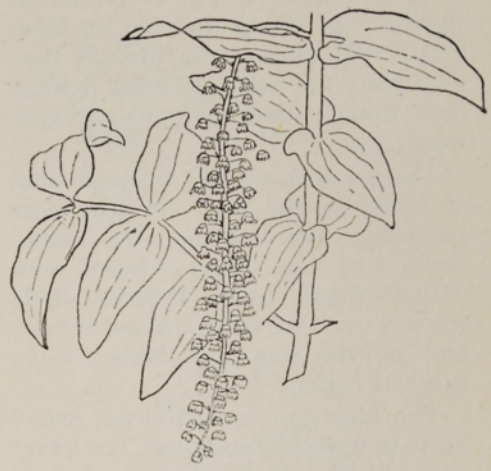
The horoeka or lancewood is a small tree with oblong toothed leaves and small flowers in clusters. There is a great change in the form of the leaf from seedling to adult. Young plants have long narrow leaves with teeth widely spaced. These grow on a thin upright stem and bend downwards. Later, leaves with three leaflets arise at the top of the stem and these are succeeded by the simple adult leaves.

Violet Family

The mahoe is a very common tree in the forests of New Zealand. The leaves are oblong and bluntly toothed. The flowers are small and borne on the twigs, mostly below the leaves. The fruit is a small dark purple berry. The wood of the mahoe is soft and white and of little use.

Tutu Family

The tutu is a large shrub with small greenish-red flowers arranged in long drooping racemes. The fruit is black and fleshy. The leaves, shoots, and seeds of the tutu are poisonous. Sheep and cattle have been killed by eating the shoots and leaves of the tutu and once a circus elephant died from feeding on tutu.



Tutu

Myrtle Family

The plants of this family are trees or shrubs. The leaves are in pairs and are dotted with minute oil drops. The ovary is woody and bears the flower parts on its rim. The stamens are numerous and long. They are often brightly coloured and form the most conspicuous part of the flower. The fruit may be a woody capsule as in manuka, rata, pohutukawa and blue gum, but in the maire it is a berry.

The manuka is the most common shrub in New Zealand. It has small, sharp pointed leaves, white flowers and woody capsules. Some varieties have pink or red flowers. The manuka forms large areas of scrub in the North Island and occurs as far south as Stewart Island. It grows equally well on dry pumice land or in swamps. It may grow into a tree.

Manuka

The rata is a large forest tree. The trunk grows to seven or eight feet in diameter and is covered with rough fibrous bark. The leaves are smooth and without hairs. The flowers have very small sepals and petals but long red stamens forming a kind of brush. The capsule is small and woody. Nectar is found in the calyx cup and

is sought after by birds which in sipping it get the feathers of the head dusted with pollen. In this way they may carry the pollen to other flowers. Rata wood is used for posts and firewood.

The pohutukawa has the same kind of flower as the rata. It is a more spreading tree and has the undersurface of the leaves covered with whitish woolly hairs. It grows along the sea coast in the Auckland district and by the shores of lakes in the thermal region.

The blue gum is a tall tree, native of Australia and Tasmania. The leaves are sickle-shaped, and hang with their surfaces vertical. The young leaves, however, are oblong and lie with their surfaces horizontal. The flower of the blue gum has a four-angled woody receptacle containing the ovary. There are numerous stamens as in the rata. but they are cream-coloured. The calyx is in the form of a woody lid which falls away when the flower opens. The fruit is a woody capsule. Blue-gum timber is very hard and is used for posts and sleepers. The leaves are the source of eucalyptus oil.

BLUEGUM

AUSTRALIAN HEATH FAMILY

The members of this family are mostly Australian shrubs. They are related to the true heaths and like them have the petals joined into a tubular corolla, but whereas the anthers in the true heaths are two-celled and open by pores at the top those in the Australian heaths are one-celled and open by splitting from top to bottom.

The neinei or grass tree is common in the Auckland district. The branches are bare of leaves except for clusters at the tips. The leaves are grass-like and drawn out into long, often spiral, tips. The flowers are borne on woody panicles arising in the centre of the leaf clusters. The capsules are woody and have five cells.

NGAIO FAMILY

The ngaio is a spreading tree that grows near the coast. The leaves are thickly studded with translucent oil dots. The corolla forms a short tube with five spreading lobes. The fruit is a small purple drupe.

SNAPDRAGON FAMILY

The koromiko is a shrub with small pale-lilac flowers arranged in racemes near the ends of the branches. In a raceme each flower is on a separate stalk attached to the central stalk. There are many kinds of koromiko and they are found from the sea-coast to

high up on the mountains. Some of the mountain kinds have small scale-like leaves and hence are known as "whip cord" koromikos.

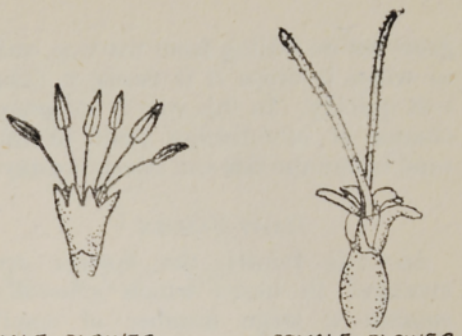
Coffee Family

The karamu is a shrub with small red drupes. The flowers are small and greenish. The flowers with stamens (male) and those with pistils (female) are found on different plants. The taupata has flowers similar to those of the karamu but the drupe is larger and the leaves are oblong and shining. It grows along the coast from Marlborough northwards. In sheltered places it may grow into a small tree. In the North Island it is frequently used for hedges.

Verbena Family

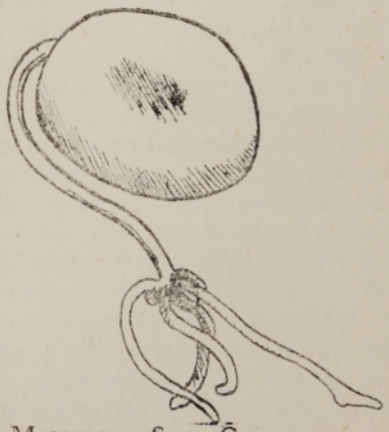
The puriri is a large spreading tree found near the sea in the Auckland Province. The leaves have five leaflets all arising from the end of the leaf stalk. The corolla is pink and is in the form of a short tube with two lips. The fruit is a drupe, pink, and in appearance similar to a cherry. The wood is very hard and is used for sleepers, bridges, and wharves. It is also used for furniture. Often it is bored by the caterpillar of the puriri moth.

The mangrove is the only tree in New Zealand that grows in salt water. It is found in estuaries between tide-marks in the Auckland Province. As the mud in which it grows does not allow sufficient air to reach the roots, peg-like roots grow upwards above the surface. The mangrove seed begins to



Karamu

Puriri



Mangrove Seed Germinating

grow before falling from the tree, and so when it drops it is ready to take root quickly. In this way it has more chance of establishing itself in the mud before the tide can sweep it away.

Daisy Family

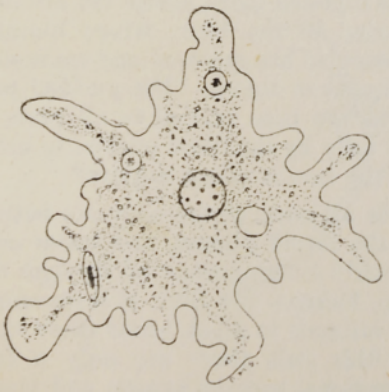
In this family the flowers are arranged in heads which generally contain a large number of small flowers or florets as they are called. Sometimes all the florets are tubular and then the head is like that of the common groundsel, but in most cases there are tubular florets surrounded by strap-shaped florets in which the petals are united into a ribbon. It is in this way that the usual daisy flower is formed. The small central florets are known as disc florets because they cover the central portion or disc of the flower head, while the strap-shaped florets are arranged round the edge and are known as ray florets. They form the rays of an ordinary daisy flowers. Sometimes, as in the dandelion, all the florets are strap-shaped. In the daisy family the ovary is below the corolla. It turns into a hard dry fruit like an achene and bears feathery bristles, which cause it to be blown about by the wind. In this way the fruits of daisies are carried long distances from the parent plants. There are many kinds of daisies found on the New Zealand mountains.

There are several kinds of small trees in New Zealand belonging to the daisy family. The commonest kinds are the rangiora and heketara. The rangiora has very large leaves, white underneath, and large panicles of small flowers without rays. The heketara has much smaller leaves, also white underneath, and the flowers have white rays.

ANIMALS

HOW ANIMALS ARE MADE UP

Animals, like plants, are made up of a great many tiny cells, but these cells differ from plant cells in not having walls. They are thus just specks of jelly-like protoplasm. But there are very different kinds of animal cells, for instance, muscle cells, bone forming cells, fat cells, and nerve cells. The blood is a fluid in which red and colourless cells, called red and white corpuscles, are carried along. Bone and cartilage are substances secreted by the bone and cartilage forming cells around which the bone and cartilage form a rigid groundwork or matrix.



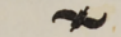
AMOEBA

A single animal cell

The different parts of the body which have special things to do are called organs. The legs are organs for walking or running, the hands for grasping and climbing, the stomach for receiving and partly digesting food, the liver for secreting digestive and other fluids, the kidneys for clearing the blood, the heart for pumping the blood, the brain for controlling the whole body, the eyes for seeing, and so on.

Although the organs have different kinds of work to do, all is for the good of the individual. The skeleton supports all parts of the body and specially protects some, as it does the brain in the skull, the heart and lungs within the ribs and various organs in the pelvis or hip bone. Muscles are attached to the bones and move them by a process of contraction, the muscle that is, becoming shorter and thicker. The heart pumps blood through tubes called arteries. The blood then passes into the very smallest vessels called capillaries and returns to the heart through tubes called veins. Blood carries digested food and oxygen. The lungs bring air to the blood, while the stomach and other organs digest and assimilate the food that is neces-

sary for growth and repair. All this work can go on only if all the organs are bathed in fluid. This fluid is called plasma. It is the fluid part of the blood. It passes through the capillary walls into the tissues of the body carrying nourishing substances and returns to the blood vessels with waste materials. These are transported in the blood stream to organs such as the liver and kidneys where they are cleared from the blood.



HOW ANIMALS FEED

Animals are unable to manufacture food from inorganic substances. They feed on organic matter, that is, other animals and plants. Consequently, they must take in solid food and for this are provided with organs to receive and digest it. The same organs deal with liquid food, such as milk and blood, and with water.

First, the food must be broken into small pieces. Mammals do this with their teeth and birds with their bills. Animals that take their food in water, such as fish and whales, gulp their food in large pieces. Most reptiles have only pointed teeth and so must swallow their food in pieces. Mammals are better able to chew or masticate their food than most other animals on account of their having teeth with grinding surfaces.

The food must be changed into substances that can be absorbed into the blood. This process is called digestion. It begins in the mouth where a fluid called saliva is poured from the salivary glands. Saliva changes starch into sugar which is soluble in water. In the stomach other juices act on the food and in the intestines the process of digestion is completed and the products pass into the blood stream. The various digestive fluids poured into the stomach and intestines change starch to sugar, proteins to the soluble peptones and emulsify or break up fats. The digested foods, except fat, are then carried to the liver, where harmful substances are removed and some substances are stored. The purified products are then carried to all parts of the body by the blood stream, to build up the tissues where required.

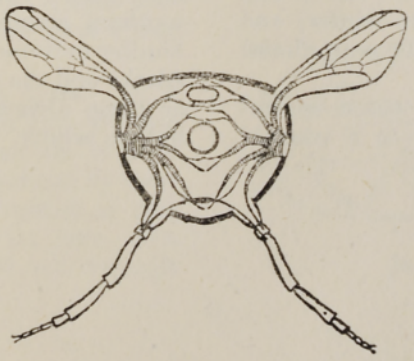
As all parts of the body are bathed in the liquid plasma, and water continually is being removed through the skin, kidneys and liver, it is necessary for animals to drink water every day. To this rule there are only a few exceptions, such as camels and goats, which can live for longer periods without water.

HOW ANIMALS BREATHE

All animals require oxygen which must be distributed to every part of the body. It is carried by the red corpuscles (or green corpuscles in some animals) in the blood. The oxygen is given up to the tissues of the body only where it is required.

Oxygen gets into the blood from the atmosphere or, in the case of animals that live in water, from the air that is dissolved in the water. In mammals, birds, reptiles and amphibians (frogs and salamanders) the air is brought to the blood in the lungs where the capillaries, or very small blood-vessels connecting the arteries and veins, are crowded on the inner surface of the lung and thus come in contact with the incoming breath. In fishes and most marine animals such as mollusca (shellfish) and crustacea, the capillaries come in contact with the water in the gills, which usually are branched so as to increase the surface.

In insects air circulates in a network of tubes with openings at the sides of the body. In all cases oxygen is taken up by the red or green corpuscles in the blood and carbon dioxide is given up and escapes from the body in the outgoing breath or, in the case of aquatic animals, into the water.



INSECT

Cross section of insect showing air tube

CHANGES WITH THE SEASONS

Many animals change their habits, or their colour, or their place of residence with the seasons. Some animals pass the coldest part of the winter by sleeping. For instance, some kinds of bears, badgers, squirrels, rats, frogs and reptiles sleep during cold weather. When animals are taking their winter sleep breathing stops or goes on very slowly, the blood circulates very slowly, their bodies become almost as cold as the surroundings, and they get thinner through slowly absorbing their fat. If this suspension of life activities reaches a dangerously low level the animal wakes up.

Many kinds of insects and snails live only for a season. Only their eggs remain alive through the winter.

Animals that change their colour during the winter are the Arctic fox, stoat (becomes ermine in winter) and the ptarmigan. They become almost or entirely white.

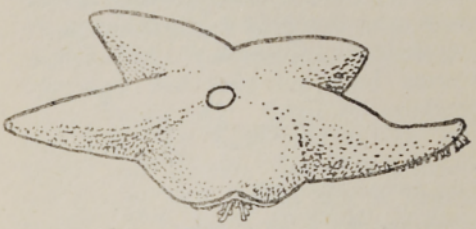
During the winter season several kinds of birds migrate to a warmer climate. It may be from the temperate regions to the Tropics or even right across the Tropics to the other temperate zone, where it will be summer when the country from which they came will be having winter. The shining cuckoo and the longtailed cuckoo breed in New Zealand, but during the winter they migrate to the islands of the tropical Pacific. The mutton bird nests in New Zealand and like the cuckoo migrates during the New Zealand winter to the Tropics or even the northern temperate zone. Several kinds of wading birds like the godwit, turnstone, and golden plover breed in Siberia, that is, in the northern temperate zone, and during the Siberian winter migrate right across the tropics as far as Australia and New Zealand, spending the southern summer in these countries. Similar movements take place between Alaska and the Argentine. Such birds as these always have two summers, but no winter, every year.

STARFISHES AND SEA URCHINS

Starfishes and sea urchins are common enough between tide marks and in shallow water. They do not look much alike but they agree in the following points:—

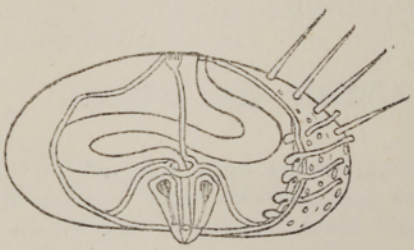
1. The outer covering is made of hard shelly plates.
2. The mouth is in the centre of the under-surface, and the body radiates in five or more regions of similar make-up.
3. There is no definite blood system but instead a system of vessels, the water vascular system, into which sea water is admitted. It enters through minute holes in a special plate near the centre of the upper side of the animal. The water vascular system contains corpuscles and takes a part in respiration.

Starfishes have long arms. In a groove underneath each arm are two rows of tube feet. These are parts of the water vascular system and by their sucker-like action the starfish is able to walk and to hold its prey. Its stomach can be pushed out through its mouth and so seize its prey and draw it inside to be digested.



STARFISH

Sea urchins have the test, as the shell is called, covered with long spines. Inside the mouth are five sets of teeth arranged in a circular structure known as Aristotle's lantern.



SEA URCHIN

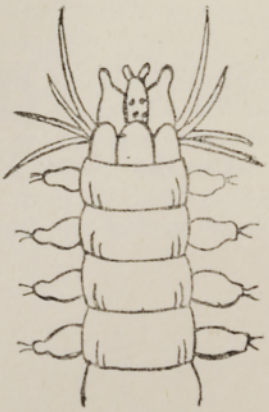
EARTHWORMS

Earthworms have no legs. Instead there are minute bristles which enable the worms to obtain a grip when pushing their way through the soil. Earthworms have no eyes but they are sensitive to light. The mouth is at the tip of the head end, and the stomach-intestine extends the whole length of the body. The nerves are arranged in a ring round the gullet and there are two main cords along the under side of the body. This is similar to the arrangement in insects and crustacea but different from that in backboned animals (mammals, birds, etc.), where the brain and the spinal cord are on the upper side of the body.

Earthworms eat their way through the soil. As the earth passes through the body the vegetable matter in it is absorbed and the remainder pushed to the surface of the ground. It forms little piles called "worm castings." Vegetable material for use as food is also dragged into the soil from the surface, and air circulates in the worm burrows. Worms are thus very important agents in forming ordinary black soil and consequently have a beneficial effect on the growth of plants.

GREEN SEA WORMS

The green sea worm is found under stones near low-tide mark. It has a distinct head with eyes and feelers, and powerful jaws. It has many pairs of legs furnished with bristles and can move fast. The mouth, stomach-intestine, and nerves are the same as in the earthworm. The throat can be turned inside out through the mouth. In this way the strong jaws within the throat are used to seize the green sea worm's prey.



GREEN SEA WORM

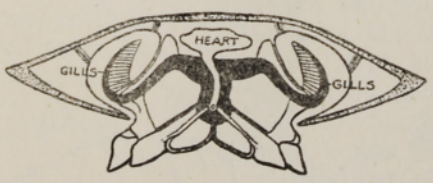
CRABS, SHRIMPS AND CRAYFISH

We now come to the great group of jointed animals. They include the crustacea (crabs, shrimps, crayfish, etc.), spiders and insects. There is no internal skeleton, but the body is covered with a more or less hard covering made from a substance called chitin; and the legs are composed of separate rigid segments with joints between them. The skin at the joints is soft and so is movable.

The crustacea live mainly in the sea, consequently, the breathing-organs are gills. They are enclosed in cavities in the body. Besides walking legs crustacea have other jointed appendages. These include feelers, the parts of the mouth and the swimming-organs. Sometimes the eyes are on stalks. Often the blood is greenish in colour. The heart is near the upper side of the body. It is surrounded by a space into which blood from the body collects and enters the heart by several openings.

The hard outer covering of crustacea cannot increase in size; hence as the animal grows it is regularly shed and a new and larger covering formed. The animals hide away during this time as they are not able to defend themselves.

Crabs have a flattened body, often wider than long. The tail is short and is folded in closely on the underside of the body. Crayfish and shrimps have long, rounded bodies. The tail is long and provided with swimming-organs. The female crab, crayfish and shrimp, carry their eggs in the fold of the tail.



CRAB

INSECTS

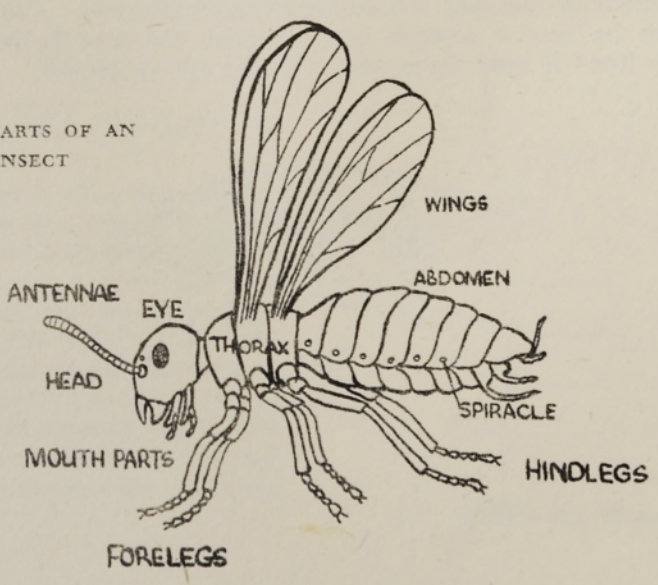
There are more different kinds of insects than there are of all other kinds of animals. They are to be found in every place where life can exist. There is a wonderful variety of forms and colours in insects. Some kinds include different forms, such as soldiers and workers, each having different work to do in the colony, and in some there are special females called queens whose duty is to lay eggs for the whole colony.

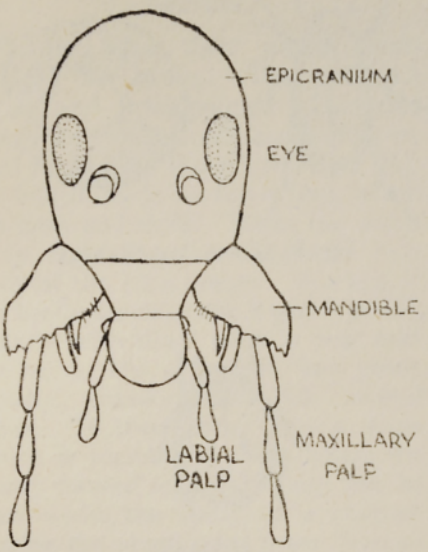
Insects may be recognised by their bodies being divided into three more or less distinct regions, head, thorax, and abdomen. The head bears a pair of feelers, or antennae, two or more eyes and three pairs of mouth parts. The thorax bears three pairs of legs and two pairs of wings, though some insects such as flies have only one pair of wings, and some, such as fleas and silver-fish, have none at all. The abdomen has no appendages but contains various organs. In having six legs insects differ from spiders, which have eight, and crabs, which have ten.

Insects have two comparatively large compound eyes, that is, each eye is composed of a large number of tiny simple eyes each having its own lens and nerve ending. There may also be small simple eyes.

Insects breathe by means of air tubes branching to all parts of the body. The air enters this system of tubes through

THE PARTS OF AN INSECT





Head of Weta

ten tiny holes, or spiracles as they are called, on each side of the body.

The blood of insects may be colourless, red, or green. It circulates mostly in spaces in the body, the only proper blood-vessel being the aorta arising from the front end of the heart. This is situated on the upper side of the abdomen and is in the form of a long tube with holes at the sides for admitting blood from a space surrounding it.

Some insects lay eggs and some bring forth their young alive. Many pass through several stages before becoming adult.

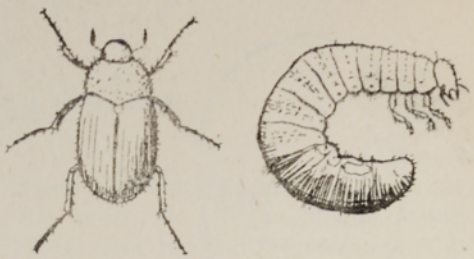
Insects feed on every kind of food. Some live on animals, including other kinds of insects. Some feed on plants, some on nectar, some suck the blood of animals.

A few kinds of insects are directly useful to mankind. The honey-bee produces honey and beeswax. Silk is the product of the caterpillar of the silk-moth. Cochineal is obtained from a small scale insect. Some insects are beneficial because they prey on harmful insects. Examples of such useful insects are a small wasp that lives on the caterpillar of the white butterfly, and a large wasp that kills the huhu grub. But many kinds of insects are indirectly useful to man, for instance those that carry pollen from flower to flower. In this way they are beneficial to his fruit trees and flowers, as well as to the trees of the forest, by increasing the chances of setting their seeds.

Many kinds of insects, however, are extremely harmful. They may feed on our crops and ruin them completely. In dry countries, such as Africa, locusts may eat the leaves of all the plants over large areas. The caterpillar of the white butterfly feeds on plants of the cabbage family. The grass grub, which is the larva of a beetle, eats the roots of grass. Aphids or plant lice suck the juices of roses. Worst of all is the great harm insects can do by carrying disease from one person to another. Mosquitoes spread malaria and yellow fever; fleas carry plague; and house-flies typhoid fever. The terrible disease, sleeping sickness, is spread by the tsetse fly. Many diseases of our domesticated animals are due to insects or are carried by insects.

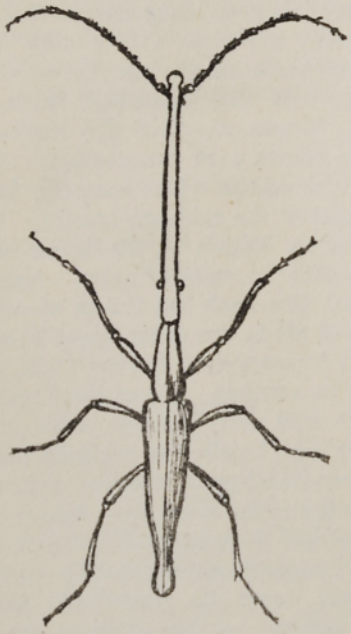
Insects may be classified under many groups. A few of these should be known to everyone.

HUHU BEETLE

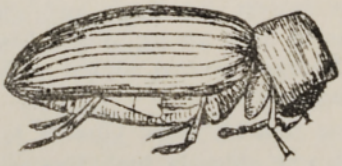


GRASS GRUB AND BEETLE

LADYBIRD



WEEVIL



TWO DIAGRAMS OF THE BORER

Beetles

Beetles have their mouth parts adapted for biting. The jaws are strong and sharp-pointed. The hind wings are transparent and alone are used for flight. When not in use they are folded inside the fore-wings, which are hard and thick. When the insect is in flight the fore-wings are held clear of the hind wings. The egg of the beetle develops into a grub (larva) usually with three pairs of legs near the head. The grub feeds and grows rapidly, changing its skin several times. It then turns into a pupa which is rounded in front where the partly formed legs and wings can be seen, while the abdomen is pointed. During the pupal stage great changes take place. Wings and legs of the adult pattern develop from the rudimentary ones and the internal organs are reconstructed. Finally the adult insect emerges from the pupa case.

The huhu beetle is a large kind with long antennae. The grub which is legless bores into tree-trunks, making them almost useless for timber.

The grass grub, so destructive to pastures, is the larva of a small brown scarab beetle.

Weevils have the head produced into a long snout. Some are harmful to foods.

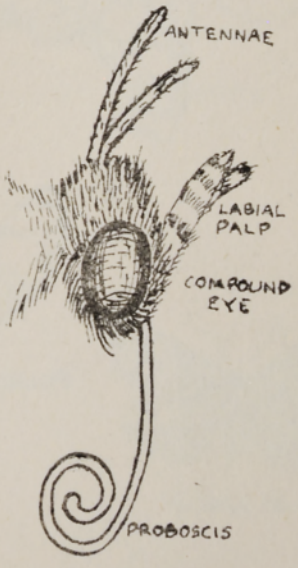
The house borer is a small beetle which damages buildings. It was accidentally introduced into New Zealand by man.

The common ladybird also is an alien.

Butterflies and Moths

Butterflies and moths have the mouth parts adapted for sucking. All four wings are broad and covered with tiny coloured scales. In butterflies the body is narrowed between the thorax and abdomen, while in moths it is tapered evenly. Butterflies have simple antennae swollen at the tips; moths have antennae of various shapes.

The eggs of butterflies and moths hatch into caterpillars, which have three pairs of short legs, with claws, on the thorax, and four or five pairs of clasping legs on the abdomen. Caterpillars feed voraciously and grow fast. Their food consists of leaves and wood. When full grown they spin round themselves a case or cocoon of silk



Butterfly Mouthparts

threads. Inside the cocoon the caterpillar changes to a pupa or chrysalis, with rounded head, pointed abdomen, and rudiments of wings and legs. While inside the pupa case, a further change takes place, the chrysalis gradually growing into the adult insect which then emerges and unfolds its wings.

The silk moth is cultivated in Japan, China, Italy and other countries. The silk of commerce is unwound from its cocoon.

The white butterfly was accidentally introduced to New Zealand from Europe. Its caterpillar is very destructive to plants of the cabbage family.

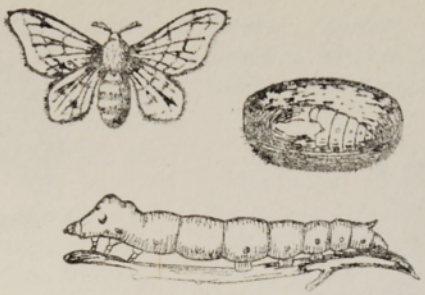
The caterpillar of the codlin moth lives inside apples. When full grown it burrows its way out, crawls down the tree and changes to a chrysalis in the soil.

The caterpillar of the puriri moth burrows into tree trunks, thus damaging the wood. The puriri moth is a large green species.

The red admiral butterfly is a large native kind. Its larva (caterpillar) feeds on wild nettles.

The magpie moth is black with white patches on the wings. The caterpillars feed on plants of the daisy family and in turn are eaten by the shining cuckoo.

PURIRI CATERPILLAR AND PUPA



Silk Moth Caterpillar and Pupa

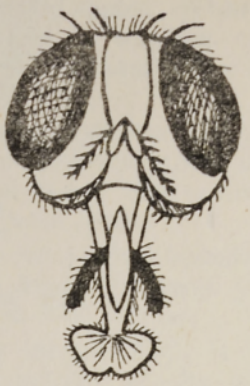
White Butterfly

Puriri Moth

Red Admiral Butterfly

Magpie Moth

Housefly



Housefly Mouth Parts

FLIES

Flies have the mouth parts adapted for piercing and sucking. There is only a single pair of wings, and they are transparent. The egg develops into a legless maggot, some kinds of which feed while immersed in dead animal matter. The maggot then changes into a bottle-shaped pupa from the case of which the adult fly in due course emerges.

The blow-fly and the house-fly are found associated with human beings in all parts of the world. The house-fly is particularly harmful in spreading diseases. It may carry the germs of typhoid fever and other diseases on its feet or in its mouth and transfer them to our food.

Mosquitoes are flies that feed on the blood of living animals. Some kinds are the carriers of the organisms that cause malaria and yellow fever.

Sandflies feed on the juices of plants and on the blood of animals.

Head of Mosquito

Ants, Bees and Wasps

Ants, bees and wasps have the mouth parts adapted for piercing and biting. They have two pairs of transparent wings. Many have a sting at the end of the abdomen.

The honey bee colony consists of three forms of insects, namely, queens, drones, and workers. The workers build combs of wax composed of six-sided cells opening towards both sides of the combs. These cells are used for storing honey for food, and for rearing the young. Each hive of bees has one queen which lays all the eggs, a few drones, or male bees, later driven away, and a large number of workers.

Ants have powerful jaws. In some species there are in the colony four forms, namely, males, females, workers, and soldiers. Workers and soldiers are wingless.

Other Insects

To other groups of insects belong wetas, cockroaches, earwigs, dragonflies, cicadas, termites, locusts, caddis flies, aphids, bugs, walking-stick insects, and many others.

Termite or White Ant

Honey Bee

MOLLUSCA

Mollusca is the name given to that group of animals mostly known as shellfish and snails. In many cases the shell is wholly inside the animal and in others there is no shell at all. But most molluscs have one, two, or eight shells. Molluscs differ from the animals with jointed bodies (insects, spiders, crustacea) in not having legs or jointed mouth parts. They have a muscular organ called the foot which is used for gliding, burrowing, or grasping objects. Air-breathing molluscs have lungs; those that live in water have gills. An organ peculiar to molluscs is the radula. This is a ribbon-like tongue and is studded with rows of minute horny teeth. It is used with a rasping action when the animal is feeding.

Bivalve Molluscs

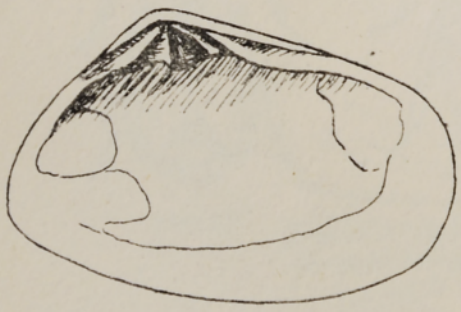
Bivalve molluscs have shells consisting of two equal or nearly equal valves joined by a hinge of horny substance. Along the hinge line of the two valves of the shell may be interlocking teeth. On opening the shell there may be seen a tongue-like foot near one end. This is used for burrowing. At the other end are two siphons, one to take water in, the other to let it out. On either side of the foot are the gills, which are delicate flat organs. That part of the animal lining the shell is called the mantle. Bivalves have no radula.

Mussels are attached to rocks by a bundle of strong fibres.

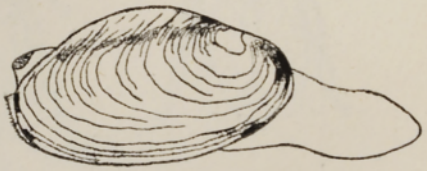
Scallops have one valve rounded and the other flat. They can swim by opening and shutting their valves.

The toheroa lives on sandy beaches. Its siphons or tubes for taking in and discharging water are about six inches long, so that the toheroa can breathe and feed while well below the surface of the sand.

Oysters have irregular shells, one valve of which is fixed to the rock and the other one, which is flat, is movable.



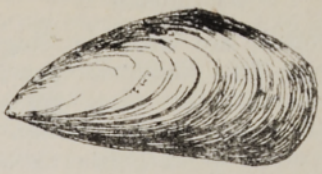
Pipi Shell



Mussel

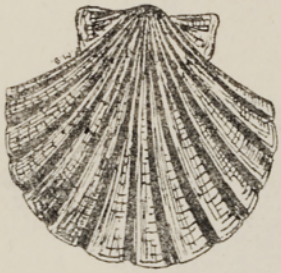
Fresh Water Mussel or Kakahi with foot in front, and siphons for intake and outlet of water behind

Bivalve Shell Showing Animal

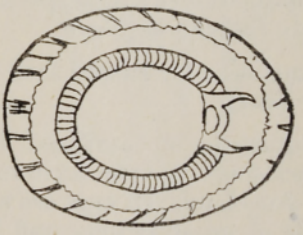


Sea Mussel

Limpet

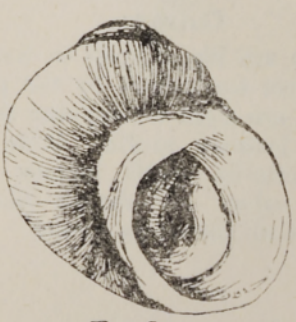


Scallop or Fan Shell



Limpet Showing Animal

Rock Oyster



Top Shell

Gastropods

Gastropods are snail- or slug-like animals. The shell is generally spirally coiled but some gastropod shells are tent shaped. Often the opening of the spiral shells is closed by a lid, or operculum. Slug-like gastropods have a small internal shell or none at all. Gastropods move by a gliding motion on the flat surface of their large muscular foot. The gills are branched and protected by the shell. In snails and slugs there is a lung formed by the mantle. A radula is present in all gastropods.

Limpets have tent-like shells. The foot of the animal is very large and surrounded by a groove in which are the gills.

The top-shell has a shelly operculum commonly called a cat's eye.

The paua is an ear-shaped shell with a pearly lining.

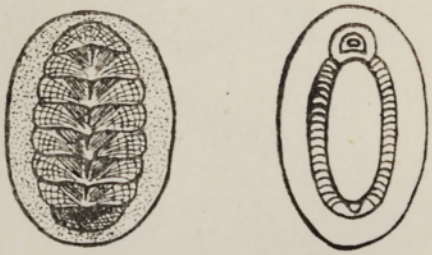
The pupurangi or kauri snail has a large black shell. It is found in forests north of Auckland. Its eggs are about a quarter of an inch long and have hard white shells.

Paua

Kauri Snail

Chitons

Chitons are like limpets in having a large foot surrounded by the gills, but there are eight overlapping shells set in a leathery girdle. Some are called butterfly shells because the separate valves are shaped like a butterfly with the wings spread.



Chiton

Top view *From below*

Octopuses, Squids, and Cuttlefish

Octopuses, squids and cuttlefishes do not look like the other kinds of molluscs. Inside the body there is a horny or chalky shell or none at all. The foot is that part of the animal in the front of the head. It is formed into eight or ten arms with suckers on their inner sides. The mouth is in the centre of the arms. These animals feed on fishes and other animals which they catch and hold by the suckers and then tear them to pieces with their parrot-like jaws.

The octopus is often seen in summer near the shore. It has eight arms.

The nautilus is like the octopus but has a shell. In the paper nautilus it is very thin and is milky-white. In the pearly nautilus it is pearly inside.

Squids have ten arms and a long horny shell or "pen." Cuttlefishes also have ten arms; but the shell is light and chalky. Squids and cuttlefishes can discharge a black liquid called sepia and under cover of this dark cloud can escape from their pursuers.

Octopus

Squid

FISHES

Fishes belong to the great group of animals called vertebrates or backboned animals. With the exception of sharks and their allies fishes have an internal bony skeleton of skull, backbone, ribs and shoulder bones. There are no ordinary limb bones but instead a number of rays supporting the membrane of the fins. There are two pairs of side fins and there are single fins on the back, tail and under surface. Sharks, rays and elephant fishes have a skeleton of cartilage or gristle. Fishes breathe by means of gills arranged on bars or arches of cartilage on either side of the throat. Water enters the mouth, passes between the gill arches and out through openings called the gill clefts. Usually, the skin of fishes is covered with scales, but in eels and some other fishes there are no scales appearing on the surface. In sharks and rays there are instead of scales little plates each composed of bone, ivory and enamel. The teeth of fishes, as in all other backboned animals, are made up in the same way as the body plates of sharks and rays, that is, of bone, ivory and enamel. In sharks and rays various stages between body plates and teeth can be seen on the lips. Fishes lay eggs which hatch in the water. Some sharks bring forth their young alive.

The snapper is caught mainly round the coast of the North Island. It has rounded teeth with which it crushes the shells of the molluscs on which it feeds.

The tarakihi has a long spine on each of the side fins. It is one of the principal food fishes of New Zealand.

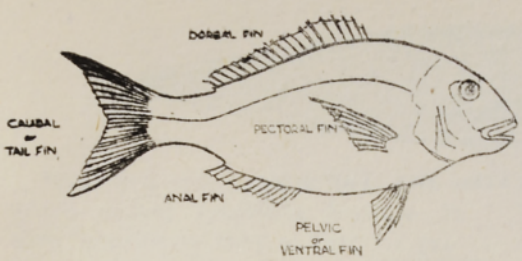
Flounders and sole are flat fishes. The upper side is coloured like the sand of the sea bottom on which they live, while the under side is white. When these fishes are hatched there is an eye on each side of the head, but soon one of the eyes travels through the head and so both appear on the same side, namely, the one that is uppermost and coloured. Thus flat fishes always lie on one side.

Other common food fishes are kahawai, mullet, gurnard, John Dory, moki, and groper.

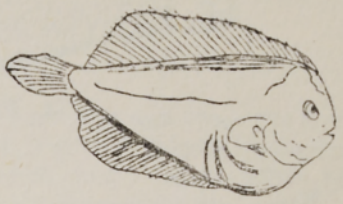
Sword fishes are large ocean-going fishes with the snout produced into a long, solid point; with this they can can impale their prey.

FRESH WATER EELS

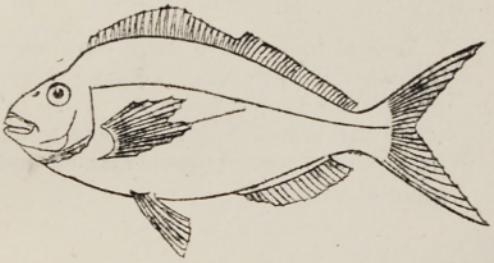
Eels are fishes that are snake-like in form but with fins and the hinder end of the body flattened in a vertical direction. They propel themselves by a wave-like motion of the body. Eels do not breed in fresh-water but when mature migrate to the ocean where at a considerable depth they bring forth their young. These are ribbon-like and transparent and swim to the surface where they soon change into a rounded form. These are called



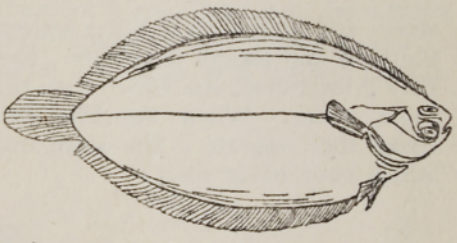
SNAPPER SHOWING THE NAMES OF THE FINS



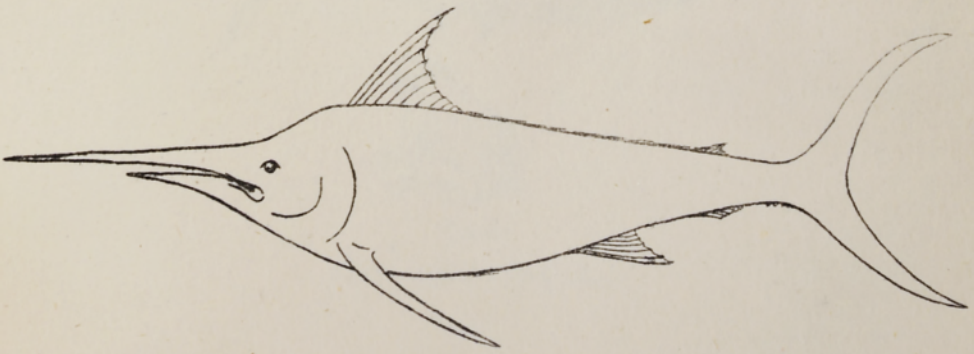
YOUNG FLOUNDER



TARAKIHI

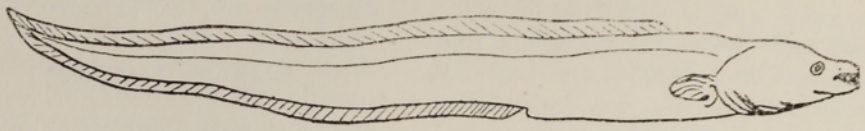


ADULT FLOUNDER



SWORD FISH

A Freshwater Eel Larva



Eel Adult

elvers and in this stage swim towards the land and ascend the rivers. Here they grow to full size which may take some years. When breeding time comes they migrate to the ocean from which they never return.

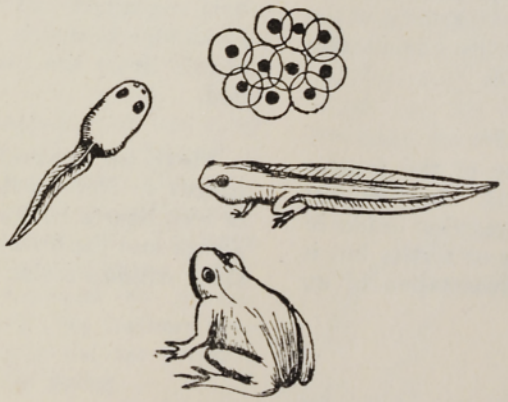
Several fresh-water fishes have been introduced into New Zealand from Europe and North America. They include the brown trout, rainbow trout, brook trout, carp, Atlantic salmon and quinnat salmon.

AMPHIBIA

Frogs and salamanders belong to a group called amphibia because in their life-history they at first are provided with gills while later they breathe by means of lungs. The limbs, like those of all vertebrates except fishes, have distinct fingers and toes.

The eggs of frogs are laid in the water and are held together in clusters by a jelly-like substance. The eggs develop into larvae called tadpoles. These have a long tail, external plume-like gills, but no legs. As the larvae grow the tail is absorbed, the gills disappear and legs and lungs are formed. In this way the tadpole changes into the adult frog. Salamanders retain their tail throughout life.

Native frogs are found in several parts of New Zealand. They are peculiar in that the tadpole stage is passed through in the eggs which are laid in damp places. The common green and gold frog was introduced from Australia. Its eggs are laid in water and there is a typical tadpole stage.



FROGS

Eggs, tadpoles and adult

REPTILES

Reptiles are mostly lizard-like in form, that is, they have long bodies, short legs, and long tapering tails; but in one group, the turtles and tortoises, the body is oblong and rounded above, and the tail is very short. In another group, the snakes, the body is eel-like and there are no legs. In former times there were flying reptiles (Pterodactyls), that looked like birds, and swimming reptiles (Ichthyosaurs), shaped like fishes.

Reptiles are covered with scales or plates. They lay eggs with large yolks, though some reptiles bring forth their young alive. They breathe by means of lungs. Reptiles are cold-blooded, that is, the temperature of the blood is about that of the surrounding air and changes with it.

Tuatara

The tuatara is one of the famous reptiles in the world. It does not belong to any of the existing orders of the lizards, crocodiles or turtles but is the only living representative of an order that mostly died out long ages ago. It is found only on islands off the coast of New Zealand from Cook Strait northwards.

The tuatara is remarkable for having a third eye partially developed beneath the skin on the top of the head.

The tuatara is olive-green with yellowish spots, and has a crest on the head, body, and tail. It lives in burrows, coming out mostly at night to feed on insects and other small animals.

It lays its eggs about November, and they incubate during the summer. In winter incubation stops. Next summer it is continued and the young hatch about March, that is, more than fifteen months from the time the eggs were laid.

Lizards

There are several kinds of small lizards in New Zealand. The skinks or rock lizards have scales. The green geckos and the brown geckos have soft skins without scales.

Tuatara

BIRDS

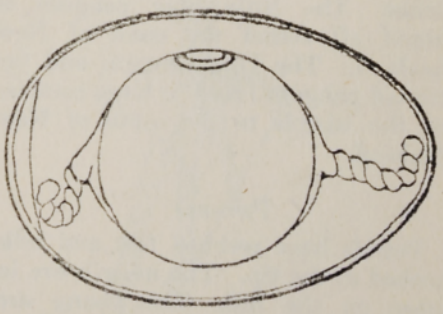
Birds are well-known and easily recognised, for no other animals possess feathers. They are friendly to man and in their ways so different from reptiles, some of which are repulsive, that it may be surprising to learn that reptiles and birds agree in many important characters. Both have scales which are formed from the outer layer of the skin and both lay eggs with large yolks. Many parts of the skeleton are similar in birds and reptiles.

Birds are warm-blooded, their temperature being constant whatever changes take place in the surrounding air. It is higher than that of mammals. The fore-limbs are modified into wings. In the bones of the wings there are only three fingers. Feathers are modified scales. They grow in the same way from the outer layer of the skin and are composed of the same horny substance. They consist of a central shaft or quill with a web or vane on either side. The vane is composed of branches fitting closely together and connected by minute hooks. This is why the feathers keep firm and can resist the air pressure when the birds are flying.

There are three conditions required for flight. (1) Strong light wings. This is made possible by feathers. (2) Powerful muscles to work the wings. The wing muscles form the breast of the birds and are attached to the breastbone, which has a wide keel. (3) An extra supply of oxygen is needed for the muscles. This is provided by a number of air-sacs or spaces into which air passes after going right through the lungs. From the air-sacs air can even enter some of the bones.

The Egg

A bird's egg consists of (1) the egg proper, which is a colourless spot on the yolk; (2) the yolk which is food for the developing chick; (3) the white, also used as food; (4) a thin membrane next to (5) the shell. There is a space filled with air at the large end of the egg between the membrane and the shell, and it is this air that the chick uses for its first breath before breaking the shell and so hatching.



Hen Egg

Kiwi

The kiwi is a flightless bird; but it has small wings under the body feathers. Kiwi feathers are soft like those of emus and ostriches. This is because the branches forming the vane have no hooks, and so the vane is not firm as it is in feathers used for flight. The kiwi has a long bill with the nostrils near the tip. In all other birds the nostrils are near the base of the bill. The kiwi has no tail. The egg of the kiwi is very large for the size of the bird. It is about five inches long and its weight nearly one-fourth that of the bird. Kiwis feed on worms and insects, coming out at night to hunt for them.

Penguins

Penguins are sea birds that are clothed with small, scale-like feathers. Only the tail has ordinary feathers. The wings are short and modified into flippers. With these, used in the same way as other birds use their wings in flying, penguins swim under water. Their bodies are shaped much like those of fishes. They feed mainly on fishes. The little blue penguin is found all round the coast of New Zealand. The king penguin and the crested penguin breed in large colonies on the islands to the south of New Zealand.

Petrels

Petrels have webbed feet and bills hooked at the tip. The nostrils are in tubes on the bill. The young are covered with soft down. The best-known petrels are the albatrosses, mutton birds, cape pigeons, diving petrels, dove petrels and storm petrels.

The royal albatross is the largest bird that flies. It is pure white with black wings. It breeds on the islands to the south and east of New Zealand. It always settles on the water to feed. It builds a crater-shaped nest in which it lays a single egg, from which, after about nine weeks' incubation, is hatched the young covered with white down.

Mutton Bird

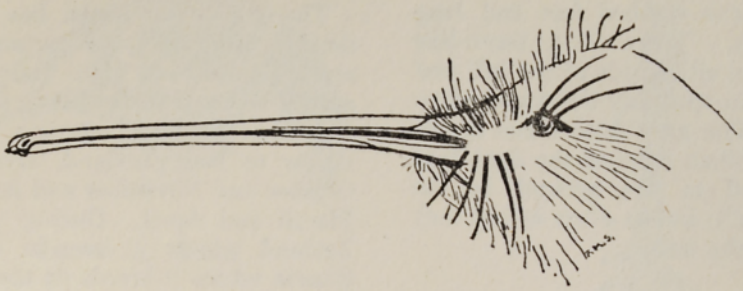
The mutton bird is sooty-brown. It breeds in burrows in immense numbers on the islands to the south of New Zealand. In winter it migrates to the warm regions of the tropics and the north Pacific. It is taken by the Maoris in large numbers for food.

Shags

Shags have webbed feet with all four toes joined. They have long bills hooked at the tip. Some breed in trees, others build nests on rocks. They feed on fish and crustacea.

Gannets

Gannets have all four toes joined by a web. The bill is large and sharp-pointed. Gannets breed in large colonies on islands off the coast of the North Island and also at Cape Kidnappers on the mainland. Only a few small colonies are found south of Cook Strait. Gannets live on fish which they catch by diving from aloft, twenty or thirty feet above the surface of the water.



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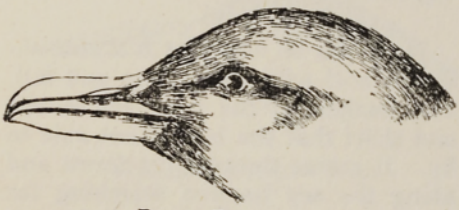
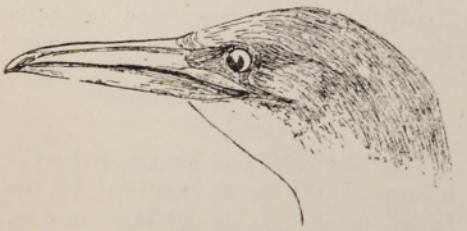


BLUE PENGUIN

WANDERING ALBATROSS

MUTTON BIRD



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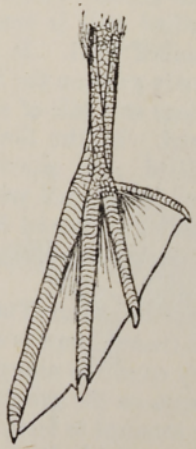


SHAG'S FOOT

Ducks

Ducks have webbed feet and long broad bills. There is a comb-like structure on either side of the bill and this helps in straining the water when feeding. The grey duck often breeds in trees. When hatched the ducklings are carried to the ground in the mother's bill; but as often as not they fall from the nest.

Black-backed Gull

The black-backed gull is common all round the coast, and especially in harbours where plenty of food from ships and factories is to be had. It builds large nests of grass on river-beds and along the coast. The young in down are grey with black spots on the head; the first plumage is brown variegated with buff; while the adults are white with black wings and back. They are very useful birds as they clear the harbours of waste food and dead animals.

Red-billed Gull

The red-billed gull is smaller than the black-backed gull. It is mostly white with pale-grey on the wings and back. The legs and bill of adult birds are bright red. In the South Island the black-billed gull practically replaces the red-billed gull which is the common small gull found from Cook Strait northwards.

White-fronted Tern

The white-fronted tern is a swallow-like bird very common along the coast. It lays two eggs on the ground, usually without any attempt to form a nest. It feeds on fishes which it catches near the surface of the sea by diving.

Godwit

The godwit or kuaka has a long, slender bill. It feeds on mud- and sand-flats between high- and low-tide marks, where it finds worms, crustacea and other animals. It is a summer visitor to New Zealand, arriving in October and November and leaving in March and April. During the New Zealand winter it lives in northern Siberia where it breeds on the tundra, or land covered only with low vegetation.

Weka

The weka or woodhen is a reddish-brown bird with strong legs and bill. The feathers of the wing are so soft and short that the bird is not able to fly. It roams through the forest and along the sea beaches searching for its food, which consists of insects, worms, and crustacea. It is a very inquisitive bird and will steal from camps small articles, especially those like tin or glass that reflect light.

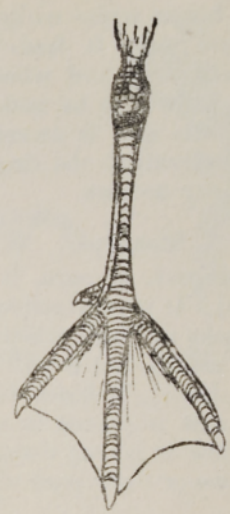
Pukeko

The pukeko or swamp hen is a well-known bird on account of its being common in swampy places and in open country generally. It is mostly purplish-blue and black, and it has bright-red feet and bill. It builds a large untidy nest of grass in the swamp and lays from five to seven spotted eggs. The young are covered with black down.

Pigeon

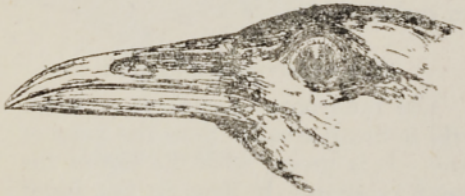
The New Zealand pigeon or kereru is one of the most beautiful of the forest birds. It is mainly bronze-green or purple with the under surface

Shoveller Duck



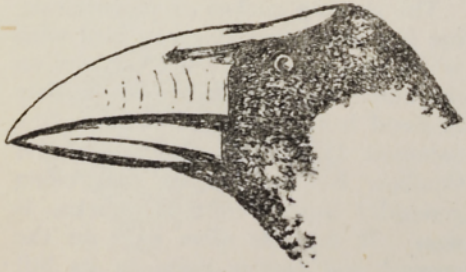
Gull's Foot

White-Fronted Tern



Weka

Godwit



Pukeko

New Zealand Pigeon

below the breast white while the feet and bill are red. It feeds on wild fruits of all sorts, and when in the winter no fruit is to be had, it feeds on leaves. Its nest is merely a few sticks through which the single white egg can easily be seen.

Morepork

The morepork, or ruru, is a small kind of owl. It is very active at dusk, when it seeks its food, which consists mainly of insects, but it will eat mice and small birds. It hides during the day. Its nest is placed in a hollow tree or a cave or among dense foliage, and in it two or three pure white eggs are laid.

Hawks and Harriers

Hawks, like owls, are birds of prey which seize their victims with their claws. These are called talons and are especially large and sharp-pointed. The beak is strongly curved downwards, as in owls, and is used to tear their prey to bits for eating or for feeding to their young. There is a bare piece of skin, called a cere, at the base of the upper mandible. The busk hawk or falcon is a fierce and fearless bird which often attacks fowl runs but its fearlessness has led to its being much reduced in numbers. The harrier is a larger bird which soars about open country looking for its prey which consists mainly of small birds and rabbits. It is quite common.

Parrots

Parrots have curved bills, the upper mandible of which they are able to move. The feet have two toes in front and two behind. This gives a stronger hold than having only one toe behind, as in most birds.

Kaka

The kaka is a large brown and crimson parrot. It has a very strong curved bill with which it can tear away bark and soft wood to find insects. The kaka also feeds on seeds, fruits and nectar. It breeds in hollow trees, laying four white eggs in a nest of decayed wood.

Kea

The kea is like the kaka but is olive-green and has only a few crimson feathers. It lives in the mountains of the South Island. Its food consists of insects and fruits, but since the arrival of Europeans a few keas have taken to eating meat.

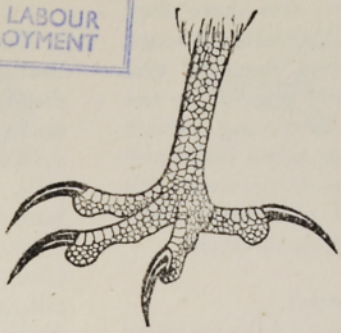
Red-fronted Parrakeet

The red-fronted parrakeet or kaka-riki is much smaller than the kaka or kea. It is green, with the top of the head crimson. It lives in the forest and feeds on fruits and seeds.

Shining Cuckoo

The shining cuckoo or pipiwharau-roa is a small bronzy-green bird with white and bronzy-green cross bars on the under surface. It arrives in New Zealand from its winter home in the Solomon Islands in September and October, its well-known call being generally heard before the cuckoo is seen. It lays its olive eggs on the ground and carries them in its bill and places them in other birds' nests,

Morepork



Claws of Harrier

Foot of Kaka

Harrier Hawk

Kaka

Parakeet

Shining Cuckoo

one egg in each nest, and there they are incubated by the foster parents. Grey warblers, tomtits, fantails, and other kinds of birds are selected by the cuckoo for rearing its young, which grows faster than the other birds and soon pushes them out of the nest. The cuckoos, young and old, leave New Zealand in February and March.

Kingfisher

The kingfisher or kotare is a familiar bird both along the coast and inland. It is deep-green above and buff below, with a collar of buff. It feeds mostly on insects but also catches fish, lizards, mice, and, occasionally, small birds. It lays its four shining white eggs at the end of a burrow which it digs in a bank or the decayed wood of a tree trunk.

Pipit

The pipit, pihoihoi, or groundlark is a bird of the open country and the sea-coast. It is quite common in all settled districts. It builds its nests in a hollow in the ground and lays in each three or four brown speckled eggs.

Grey Warbler

The grey warbler or rironiro is a small bird that is quite common in the settled districts. Its presence always can be known by its pleasant trill. It builds a covered nest with the entrance at one side. The nest of the grey warbler is generally preferred by the shining cuckoo, whose young is brought up by the proper owners of the nest, and this in spite of the fact that the grey warbler's own young may be thrown out by the hungry young cuckoo.

Fantail

The fantail or piwakawaka is a bird that not only is common in the settled districts but becomes so friendly as to enter tents and houses in search of insects. There are two kinds of fantails, the black fantail and the pied fantail, the latter having some of the feathers of the tail white. These two kinds breed together but the young are not mixed in colour but always either black or pied. Fantails feed on small insects which they take on the wing.

Silvereye

The silvereye or tauhou is a small greenish bird with a white ring round the eye. When the breeding season is over it goes about in flocks, never staying long in one place. It feeds on soft fruits, nectar and insects.

Tui

The tui is easily recognised by the tuft of curled white feathers on the throat. It is a pugnacious bird that chases away all other birds from near its nest. It is found in the settled districts as well as in the forest, and sometimes comes into the larger towns, especially in the spring when flowers begin to become abundant. The tui feeds on soft fruits, nectar and insects. Its song consists of a great variety of musical notes and is heard mostly in the breeding season.

Bellbird

The bellbird, like the tui, feeds on nectar, fruits and insects. It is called the bellbird because of its beautiful bell-like notes which are heard more often in the early morning than at other times of the day. It is a greenish

KINGFISHER

PIPIT

GREY WARBLER

FANTAIL

SILVEREYE

TUI

bird and is common in some localities though formerly it was abundant all over New Zealand.

Introduced Birds

Several kinds of birds have been brought to New Zealand by Europeans and have become wild.

There are several finches which feed mostly on seeds, for instance, goldfinch, chaffinch, and yellow hammer. All have short, strong bills.

The sparrow belongs to the weaver family. It feeds mainly on seeds. Because it eats wheat and oat seeds it is harmful to farmers; but it feeds its young on insects and so is very useful in preventing harmful kinds of insects from increasing.

The thrush and blackbird feed on insects and also fruits. Sometimes they are harmful to orchards.

The magpie was introduced from Australia. It eats large numbers of insects which it finds in fields. Because it swoops at people who approach its nest it is sometimes dangerous, especially to children.

The starling feeds on insects which it finds mainly in the fields. For this reason it is an extremely useful bird.

The black swan was introduced from Australia. It feeds on water plants which it obtains from the bottom of rivers and lakes.

The Californian quail was introduced from the United States. It feeds on seeds and insects.

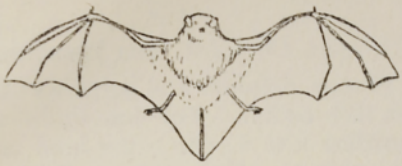
MAMMALS

The only kinds of land mammals that were found in New Zealand when the Maoris arrived were two kinds of bats. The Maoris introduced dogs and rats, and later the Europeans brought in a number of other kinds. There are several kinds of seals and whales in the seas of New Zealand.

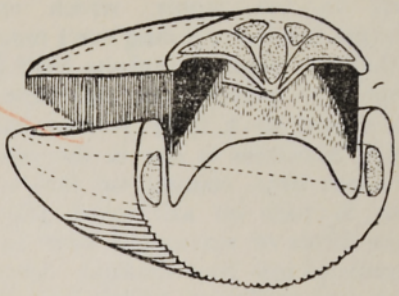
Land mammals have four limbs; but whales have only two, and these are modified into flippers. All mammals have hair. The blood of mammals is warm, though not so warm as that of birds. Only the Australian platypus and spiny anteater lay eggs. All other mammals bring forth their young alive. At first they are fed on milk secreted by the breast of the mother.

Marsupials

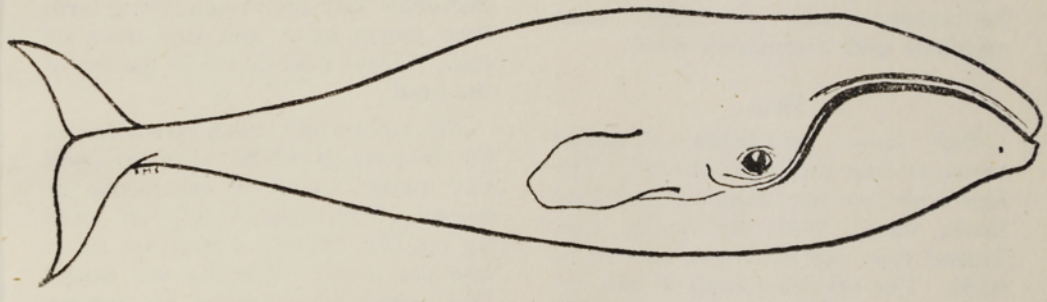
Marsupials or pouched mammals are found in the Australian region and America. They differ from all other mammals in their young being born in a very undeveloped state and only an inch or so in length. The little one, which at first looks like a red grub, crawls over its mother's body to a pouch which she has and fastens



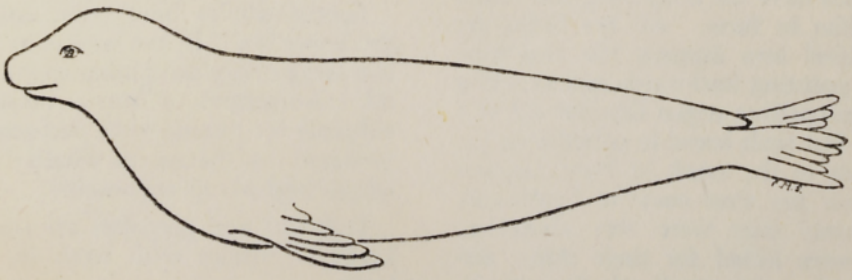
Bat



Head of Baleen Whale



Right Whale



Seal

itself to the nipple, which soon enlarges inside the young one's mouth so that it is unable to release itself for about four months. By this time it has grown to a fully formed baby which continues to live in the pouch for some time, coming out now and then to feed on soft-leaved plants. Some kinds of marsupials have been introduced into New Zealand. Among them are wallabies, which look like small kangaroos, and opossums. The opossums are now plentiful in forest country and supply large numbers of skins which are useful for their fur. Other kinds of marsupials are kangaroos, koala or teddy bear, wombats and Tasmanian devil.

Bats

Bats have membranes stretched across all four limbs and the tail. The fore-limbs are very long and the hind limbs short. With the wings thus formed they can fly almost as well as birds. The two New Zealand bats are quite rare. They come out at dusk and catch insects on the wing.

Seals

Seals have the body long and rather fish-like in form. All the limbs are modified into flippers, the two hind ones pointing backwards and so acting as a propelling organ like the tail of a fish. Fur seals breed in colonies on the islands to the south of New Zealand and on the west coast of Southland. Formerly they were very abundant, but were killed for their skins, and now only a few small colonies remain. Sea lions and fur seals differ from the ordinary seals in being able to turn their hind flippers forward and so walk or waddle along.

Whales, Dolphins and Porpoises

Whales, dolphins and porpoises have fish-like bodies. The fore-limbs are modified into flippers; the hind ones are absent. The tail is flattened horizontally. In fishes the tail is vertical. The cetacea, as whales, dolphins and porpoises are called, propel themselves through the water by means of their powerful tails. Like all other mammals they breathe air, bring forth their young alive, and feed them on milk. Their nostrils are at the top of the head.

The right whale, the blue whale and the humpback whale have no teeth but instead plates of whalebone or baleen. They feed mainly on small shrimp-like animals which are taken into the mouth with the salt water. The whale then raises its tongue forcing the water out between the plates of baleen, but the inner fringed edges of the baleen plates stop the animals which are then swallowed.

Sperm whales have teeth only in the lower jaw. In the enormous head is a large cavity containing spermaceti oil. Ambergris, a waxy substance valuable for mixing with perfumes, is produced by the sperm whale. It is found washed up on beaches.

Dolphins and porpoises are smaller kinds of whales with teeth in both jaws.

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