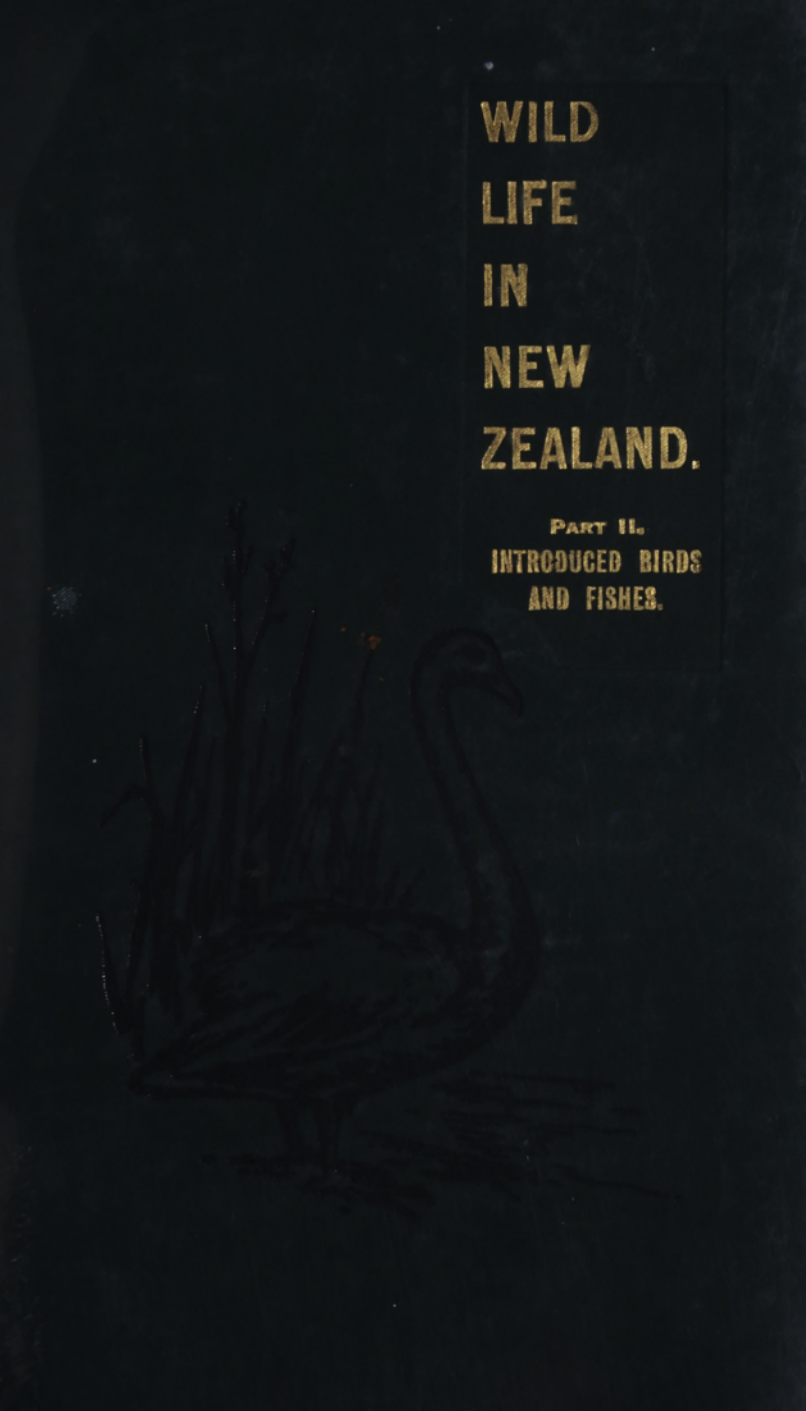
WILD LIFE IN NEW ZEALAND.

PART II.

INTRODUCED BIRDS AND FISHES.



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WILD LIFE IN NEW ZEALAND.

Part II.—Introduced Birds and Fishes.

BY

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ILLUSTRATED.

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PREFACE.

THE idea of writing this little book arose from the fact of one of my grandchildren describing to me a bird unknown to him which he had seen on the Town Belt of Dunedin, and which I recognized as a redpoll. Investigation showed that none of my young people knew whether most of the birds with which they were acquainted were natives of New Zealand or were introduced. The *School Journal* has done a good deal to enlighten them on this subject, but its teachings are not always permanent. I found also that few anglers knew that there were more than half a dozen kinds of introduced fishes. Descriptions of all the birds and fishes that have gone wild in this country are to be found scattered in British, Australian, and American works, and it seemed to me a good idea to write a brief account of these animals for the benefit of that large class which takes an interest in natural history. In the preparation of it I have relied to a considerable extent on my own notes, but have received much valuable assistance from correspondents in various parts of the country. Some of these are referred to in the text, but I would especially mention my old friend Mr. W. W. Smith, of New Plymouth, who is the veteran naturalist of New Zealand.

I hope this little book will help the young people to a better knowledge of the natural history of their beautiful country.

G. M. T.

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WILD LIFE IN NEW ZEALAND.

PART II.—INTRODUCED BIRDS AND FISHES.

CHAPTER I.

INTRODUCED BIRDS.

WHEN Europeans first came to New Zealand they were greatly interested in the birds, which charmed their ears with their bell-like notes, but they did not see nor even hear of the more remarkable kinds which are peculiar to these Islands. In later years, when naturalists began to study more closely and to collect more specimens of the bird-life, they discovered that, while all the species met with were new to them, many were of a unique character, especially such birds as the kakapo, the wingless kiwi (*Apteryx*), and the huia.

They found that there were more than ninety species of land-birds, and about as many of sea-birds. But the distribution of the former was peculiar. Rather more than one-half of the total number of land-birds were found to occur in both Islands of New Zealand. Of the other half, some were confined to one Island only, such as the huia in the North, and the kea in the South Island. Others were confined to the outlying groups of islands—the Kermadecs, Chatham, Antipodes, Auckland, and Campbell Islands. Others had a still more limited distribution, being confined to one small island: examples were the Chatham Island fern-bird, found only on the Island of Mangare, the little wood-robin on The Snares, and the Stephen Island wren. The history of the native birds of New Zealand has been very well and fully worked out, and books and papers on the subject are numerous. Since the days of early discovery seven or eight species have become extinct, and several

others have become very rare. One species, variously known as the white-eye, wax-eye, or blight-bird, which came over from Australia about seventy or eighty years ago, and quickly spread over the country, may almost be added to the list of native birds, for it was not introduced by man.

After European settlement began in the colony, private individuals and acclimatization societies commenced to introduce foreign birds, chiefly from Britain, and to liberate them in the country. Some were brought in because they were game birds, some to combat the insect pests which were becoming a serious menace to farmers and gardeners, and some for æsthetic and sentimental reasons. In this way nearly 130 species of birds have been introduced into New Zealand, but of these not more than twenty-eight (or perhaps twenty-nine) have established themselves and become wild. These are the only birds dealt with in this little book, which seeks to make known those species which are wild, but are not indigenous to the country.

1. Mallard: Common European Wild Duck (*Anas boschas*).

This beautiful bird is the parent species of our common domestic ducks.

Continuous efforts have been made to naturalize mallards in New Zealand both by acclimatization societies and private individuals. The Otago Society began its importation in 1867, and repeated the experiment frequently in the years following. The Canterbury, Wellington, Auckland, and Southland Societies have also attempted to naturalize the species. But unless the birds are carefully watched and protected they invariably disappear. In more recent years small tame flocks have been kept by some of the societies, and young birds reared from these have been scattered far and wide. In this way the mallard has become partially established in the southern part of the South Island, and, indeed, was common enough in Otago in 1915 for the Acclimatization Society to grant licenses to shoot them. These birds are also to be met with in lakes in the Waikato district. Without a very close protection the mallard cannot survive. Even with this it is far from being common.

The drake is a gaily-coloured bird, and is about 2 ft. long, with a wing-length of 10½ in. to 12 in. The head and upper part of the

neck are of a rich glossy green colour, with a nearly complete narrow ring of white below that; behind the neck is a patch of greyish-brown; the middle of the back is a dark umber-brown, while the rump and tail-covers are deep velvety black. The central tail-feathers are curled up; the wings are ash-brown, with a beautiful purple-blue speculum on each side; the breast is deep chestnut passing downwards into greyish-white. The yellowish-green bill tipped with black, the brown irides, and the reddish-orange legs and feet characterize this fine bird.

[*After Bonhote.*

FIG. 1.—THE MALLARD (*Anas boschas*).

The duck is more soberly coloured than her mate, the upper parts being a somewhat uniform dark brown, the under-parts buff streaked with dark brown, while the wings resemble those of the male.

The mallard usually nests near a lake or lagoon, among high grass or bulrushes; but sometimes the nest is placed in a hollow under a tree or on the ground at a considerable distance from water. The nest is made of grass, rushes, or straw, and lined thickly with the bird's own down. It usually contains from ten to twelve greenish or greenish-white eggs, which are a little over 2 in. in length.

2. European Widgeon or Wigeon (*Mareca penelope*).

I include this duck among the introduced birds only because in recent years it has been reported as nesting in the Auckland District and rearing large broods of young. Unfortunately, they all disappeared in 1922. It is hoped that they have merely migrated to some other part, but so far this has not been recorded. The bird is a migrant in Britain, where large numbers arrive in September from the far North, and the majority leave again in spring, only a few remaining in Scotland and breeding there. The hereditary instinct is so strong in migratory birds that the probabilities are that in their new home they try to do what their ancestors have done for countless generations, and leave for what are to them new and unknown regions. This is the most likely explanation of many failures in bird-naturalization in New Zealand.

Widgeons were first introduced into Canterbury in 1868. In later years some were brought to Otago, then a lot were imported by the Government, and others by the Auckland Acclimatization Society.

The widgeon is a slightly smaller duck than the mallard. Its length is from 18½ in. to 20 in., and its wing-length about 10·5 in.

The male has a chestnut-coloured head and neck, with a broad buff stripe extending backwards over the crown; the chin is black, the upper parts finely marked with wavy light- and dark-grey lines. There is a conspicuous and characteristic white shoulder-patch, and a green speculum edged with black. The under-parts are white, with wavy grey lines on the sides, and with a black patch under the tail. The bill is blue-grey, tipped with black. The feet are dark brown. In the female bird the upper parts are dark brownish-grey, the head and neck are mottled with light and dark brown, the shoulders are whitish, the speculum greyish. The under-parts of the body are white.

The nest is placed among rushes or long grasses, and is generally lined with the bird's own feathers. The eggs number from seven to ten, and measure about 2·3 in. in length by 1·5 in. in breadth.

3. Canada Goose (*Branta canadensis*).

This handsome goose is considerably larger than the wild grey lag goose, from which our domesticated birds are descended. A full-grown gander is as much as 42 in. in total length, with wings varying from 16 in. to 20 in. long, and weighs from 10 lb. to 12 lb.

It is a distinctively coloured bird. The head and nearly all the neck are black, but with a triangular white patch on each cheek; these patches meet on the throat. The back and the wing-coverts are brown; the primaries and the tail-feathers black. The breast and belly are brownish, fading gradually into white on the vent and under the tail-coverts; the bill is black; the legs, toes, and membranes are dark lead-colour, almost black.

The goose resembles the gander in colour, but is somewhat smaller. Attempts were made by the Wellington Acclimatization Society to naturalize this species in 1876 and 1879, but these were unsuccessful. The Government imported a number of birds in 1905, and distributed them in Southland, Otago, Canterbury, and

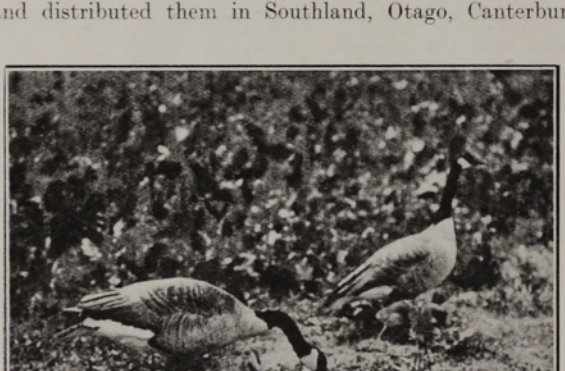


FIG. 2.—THE CANADA GOOSE (*Branta canadensis*).

Wellington. They seem to have held their own in several localities —*e.g.*, Lakes Manapouri, Te Anau, and Hawea, Waiwera, Glenmark, and Lake Sumner—and they are increasing. This is a somewhat remarkable fact, for in North America, its natural habitat, this bird is nearly always a migrant, breeding as a rule in the far north and coming south for the winter. Only a few remain to breed in temperate North America. I have not heard of the occurrence of the bird in the North Island of New Zealand.

These geese nest in the month of October in swamps and near streams, not forming a regular nest, but making a depression in the dry grass, sedges, or rushes, in which they lay from five to

seven eggs. The nesting season is the only time the birds can be approached at all nearly. The goose sits close, but the gander is never very far away. The young are not frequently seen, and they do not commence to fly till about the middle of January.

In winter the birds gather into flocks and come out on to the stubbles, young grass, or turnips of the farmer. While feeding they are so wary that it is almost impossible to get near them, and several individuals of the flock seem to keep watch. During summer they feed largely on aquatic animals (such as snails, small fish, &c.) found in the swamps and marshes, but much of their food is of a vegetable character. When feeding on grass they leave it as closely cropped as if a flock of sheep had been over the ground.

They have a very rapid and powerful flight. When flying any distance they gather into V-shaped flocks, and it is generally believed that an old gander forms the apex of the flock. An American writer (V. Bailey) says: "Few wild-bird notes are more inspiring than the *honk, honk, ha wonk, honk,* of a long line of Canada geese, flying with apparent deliberation but with really terrific speed overhead, calling as they go in notes that carry for a mile over marsh, lake, and prairie. The big, strong wings whish loudly overhead far out of shot-gun range, and often a low conversational gabble can be heard under the loud honking."

4. Australian Black Swan (*Chenopis atrata*).

This beautiful and conspicuous bird is now so common throughout New Zealand that it is often difficult to make people believe that it is not a native. Yet the first arrivals were introduced from Australia by the Nelson Acclimatization Society in or just before 1864. In that year also Sir George Grey imported some into his island home in Kawau, and later on the Canterbury, Southland, and Otago Societies, the latter especially, liberated considerable numbers. Wherever introduced they quickly established themselves, and spread over the whole of New Zealand from Stewart Island to the extreme north. They are not migratory birds to any extent, but when they shift their quarters they fly in small flocks at night, especially on still moonlight nights, when they can be seen in the sky, and their low whistling note be continually heard as they call to each other.

FIG. 3.—THE AUSTRALIAN BLACK SWAN (*Chenopis atrata*).

While lacking the size and something of the grace and majesty of the white swan, the black species is a handsome bird on the water. The male is fully 40 in. in length, and its wings are about 19 in. long. The plumage is black or brownish-black, the under-surface being paler than the upper; the primaries and secondaries are pure-white. The bill is pinky-scarlet, crossed near the tip with a broad band of white; the extremities of both mandibles are white. The irides of the eyes are scarlet. The feet are black. Altogether it is a striking bird. It has a rather feeble little whistling pipe. The female is similar to the male, but smaller.

The nest is a large, bulky structure of sticks, rushes, and reeds, usually built in a swamp, and sometimes even floating on the surface of the water. The eggs, as a rule, number from four to six; they are greenish-white, greyish-green, or green washed with brown, and are over 4 in. long, by 2½ in. across their shortest diameter. Occasionally more than seven eggs are found in a nest, but this is probably due to more than one bird using the same nest. A few nests may be found in August, but the main breeding season extends from September until December. A second brood is occasionally found in February or March, and a few scattered nests with eggs may be found well into autumn.

The period of incubation is about thirty days, and when hatched the young cygnets at once leave the nest and follow the parent birds.

Black swans feed on water and swamp weeds, and this is, no doubt, the explanation of their remarkable abundance in shallow lakes and lagoons, where the vegetation is abundant and food is easily obtained. The birds keep down any excess of weeds, and thus are of value in preventing accumulations of vegetable matter in such localities.

5. Common Pheasant (*Phasianus colchicus*); Chinese Pheasant (*Phasianus torquatus*).

The English pheasant was not originally a native of Britain, for in the wild state it is confined to the region of Europe and Asia lying to the south-west of the Caspian Sea. It was probably introduced into the British Isles by the Romans. Its technical names are derived from the River Phasis, in Colchis, a region of note in

classical lore, now known as Mingrelia, which lies south of the Caucasus, under the great peak of Elburz. In this part of the world it is still abundant. It is doubtful if pheasants would survive in England if left entirely to themselves. They depend a good deal on the amount of artificial food which is supplied to them in preserved woods and forests, while most of the young are reared by domestic fowls, and hence are only half wild.

Towards the end of the nineteenth century another species, the ring-necked or Chinese pheasant, was introduced into Britain. This bird is a native of Manchuria, Korea, and east China, and is readily

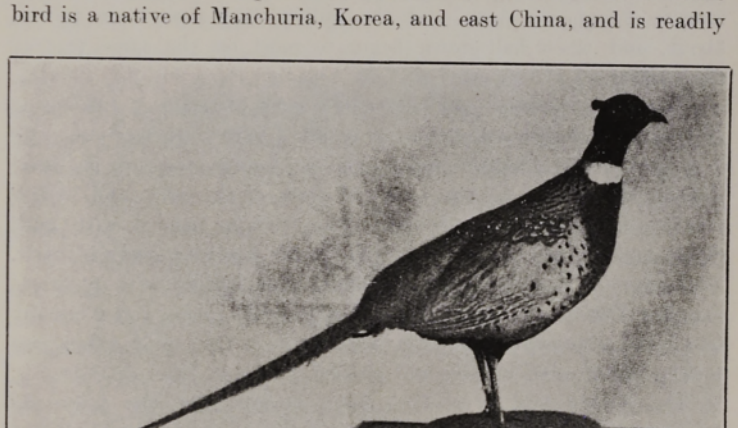


FIG. 4.—THE PHEASANT (*Phasianus colchicus* × *Phasianus torquatus*).

distinguished from the western form by its white collar. But the two species have crossed very freely, and pure examples are now difficult to get in Britain. The beautiful dark-brown colour of the plumage, with its bars and spots of darker hue on each feather, and the play of light and shade varied by rainbow colours on the neck and back, are very varied.

A large cock pheasant measures nearly 3 ft. in length to the extremity of the two central tail-feathers, which in extreme cases are nearly 2 ft. long. The spread of his wings is about 2 ft. 8 in. He will weigh as much as 3 lb., though the heaviest recorded weighed 4 lb. 9 oz. The hens are smaller and more quietly coloured.

The pheasant is polygamous, each cock securing from six to nine hens for his harem. At the mating season it is not an uncommon thing for these birds to visit the farmyards, and to fight and sometimes kill the domestic cocks.

Pheasants do not make much of a nest; it is usually a hollow among grass or fern on the ground. From September to November the hens lay from six to fourteen eggs of a light olive-brown colour, minutely dotted over with darker spots. The eggs are about 1·8 in. long, by 1·4 in. broad. Incubation takes from twenty-four to twenty-six days, and the pullets very soon learn to run about, and when half-grown begin to roost on the same tree as the mother.

How many persons could describe a cock pheasant in full spring plumage? My own attempt is, after all, a very imperfect one. He is a gorgeously coloured bird, with the bronze-green of his head shading into purple on the sides and front of the neck, and with a mantle of bright orange behind. The back is banded with buff, black, and orange-red feathers, each feather a colour study in itself. The front is of a fiery orange colour, each feather with a purple margin: this passes below into a dark purplish-green, and gradually into reddish-brown under the tail-coverts. The tail-feathers are brown, edged with purple, and crossed by black bars.

The female bird is much quieter in hue than the male, the brilliant colour contrasts being toned down to a plainer black and brown. This quietness of colour is common in birds which sit on open nests, as it tends to render them inconspicuous in the midst of the surrounding living and dead vegetation. The female is also a much smaller bird than the cock, averaging only about 24 in. in length.

The Chinese pheasant is a slightly smaller bird than the English species, but it is distinguished chiefly by the white ring round the neck, and by having the lower part of the back, the rump, and the upper tail-coverts of a greenish-slate colour.

The wild New Zealand bird is a cross between the two species, but the characteristic white ring of the Chinese species is almost always present.

English pheasants were first introduced into New Zealand in 1842, when a cock and three hens were landed in Wellington. In succeeding years others were brought to Mangonui, Nelson, Banks

Peninsula, Otago, and Southland. Chinese pheasants were first liberated at Auckland in 1851, and later some were brought to Canterbury. By 1870 pheasants had increased to such an extent that they were abundant in both Islands. But from that date they have diminished so remarkably as to have been nearly exterminated in the South Island, and to have become rare in the North. They are now found chiefly in those districts where young birds are reared under hens from the egg, and then turned loose as they approach maturity. The causes of this disappearance are pretty well known. When rabbits began to increase to a dangerous extent in certain districts phosphorus poisoning was largely resorted to in order to reduce their numbers. But the poisoned grain was freely eaten by pheasants and other ground-birds, which were greatly decimated by this means. Hawks were also carefully protected by sheep-farmers and landowners generally, as they preyed on the young rabbits. Unfortunately, they also preyed on the young pheasants, and effectually prevented the increase of these birds.

A second and perhaps the most potent cause of the reduction and subsequent disappearance of the pheasants was the introduction of starlings and small insectivorous birds from 1867 onwards. As these increased in numbers they ate out much of the insect-life on which the pheasants, and particularly the young poults, fed. The young birds were dragged through long grass and undergrowth to find sufficient food, they were subject to attack from rats and woodhens, and in these ways the natural increase of the birds was checked, and in many districts completely arrested.

Lastly, about 1882 the importation of stoats and weasels to check the rabbit plague commenced, and these animals have completed the work of destruction already well in progress. In addition to these three main causes, to which the injury caused by wild cats may be added, there has to be considered the poacher and the pot-hunter. The final result is that pheasants are now found only in districts where the local acclimatization societies rear and liberate young birds, and do their best to protect them.

6. Australian Quail, or Swamp-quail (*Synoecus australis*).

This pretty little bird is more nearly allied to a partridge than to the true quails. It has a call like that of the common European partridge, and, like it, goes in coveys of from ten to eighteen in

number, which rise from the ground simultaneously, and pitch again within a hundred yards of the spot whence they rose. "It sits so close that it will often admit of being nearly trodden upon before it will rise." It weighs rather less than 5 oz., and its flesh is said to be delicious.

The length of the bird is about 6 in., though large ones have measured up to 8½ in. Its whole upper surface is irregularly marked with beautiful transverse bars of grey, black, and chestnut, each feather on the back having a fine stripe down the centre; most of

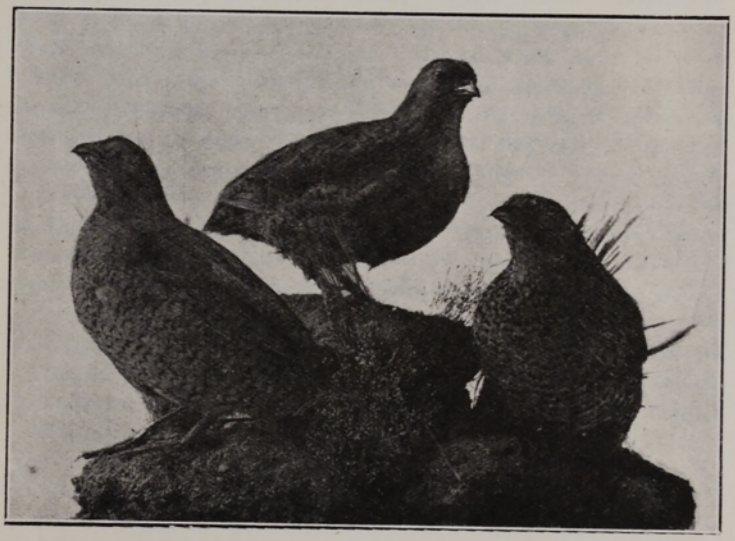


FIG. 5. THE AUSTRALIAN QUAIL (*Synoecus australis*).

the head is more or less greyish or buff-white; the under-surface is buff-grey, each feather having numerous zigzag markings of black, and many of them having a very fine line of white down the centre; the bill is blue, deepening into black at the tip; the irides are orange; and the feet a dull yellow.

The swamp-quail breeds on the ground, where it constructs a slight nest of grass and leaves. The eggs number from ten to eighteen, and are very variable in form. Normally they are broad ovals with one end much pointed. In colour they range from a

uniform bluish-white, occasionally marked with a few minute dark scattered dots, to creamy or greenish white, and even to dull pale-stone colour, speckled or blotched with grey, rufous, or brown. They are about 1·2 in. long by 0·9 in. to 0·95 in. broad.

This little bird was first introduced into Canterbury in 1866, and in subsequent years into Auckland, Wellington, Otago, and Southland. It never seems to have succeeded in the South Island, but it increased rapidly at first in the North. As, however, it keeps pretty close to the ground, it is greatly preyed on by stoats, weasels, cats, rats, hawks, and wekas, and it has become rare in the Wellington, Taranaki, and Hawke's Bay Districts. It still occurs in the Auckland District.

In 1869 the Auckland Acclimatization Society introduced what was known as the Tasmanian swamp-quail (*Synoecus diemenensis*). This is only a synonym for the Australian species, of which it is a slightly larger form.

7. Californian Quail (*Lophortyx californicus*).

This beautiful bird is a native of California, as its common and specific names imply, and there it is sometimes designated the top-knot quail, on account of its characteristic crest. The head is black, and carries two black club-shaped feathers; the forehead is yellow, the upper parts olive-grey, the mid-breast is buff, and the belly orange-chestnut and sometimes a rich golden brown, shading into white or whitish-buff on the sides and under-parts. In the cock bird a white band connects the eyes and continues behind them. The female bird has a shorter and browner crest than the cock, it lacks the black-and-white pattern on the head, its throat is a yellowish-brown, and the lower parts are whitish. This quail is altogether a very dainty and prettily marked bird; its average length is 9½ in.

In late autumn the quail gather into flocks, but in the early spring the flocks break up, and each pair of birds selects a suitable nesting-place. The nest is a very flimsy structure—a slight hollow scratched in the ground, and sparingly lined with grass or any other convenient material, usually serves the purpose. In this from twelve to sixteen eggs are laid, and these are sat on by the hen bird alone for about twenty-one days. The eggs are pear-shaped, usually of a creamy-white colour, more or less

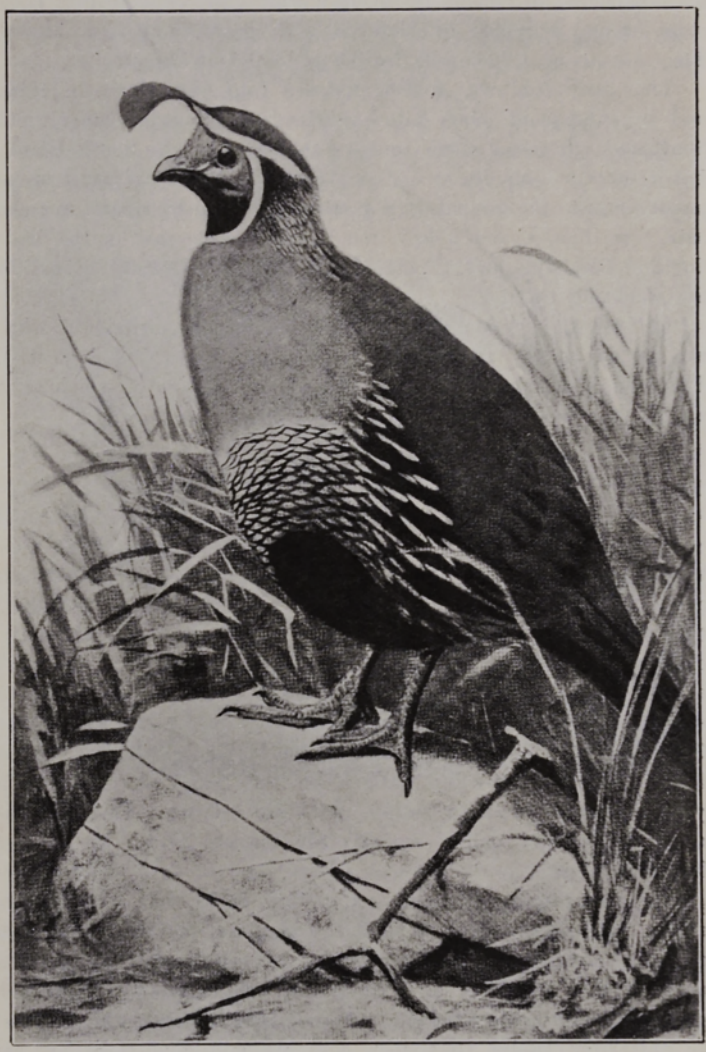


FIG. 6.—THE CALIFORNIAN QUAIL (*Lophortyx californicus*).

spotted or blotched with dark brown, pale rufous or yellowish-brown. The average length is $1\frac{1}{4}$ in., and the breadth usually just under 1 in.

While the female is incubating, the male usually mounts a stump or post in the vicinity, and frequently utters a long-drawn note.

As soon as they are hatched the chicks run about, and feed on insects and small seeds. When alarmed the old bird gives one or two notes of warning and flies away. The young, while still too small to fly, hide quickly under any convenient cover, and lie close to the ground until the danger is passed, when they are called together again by the parent.

Californian quail were first introduced into Nelson in 1865, and, later, numbers more were brought to Auckland, Canterbury, Otago, and Wellington. They increased very rapidly at first in all parts of the country, and were so abundant in the Nelson District about 1890 that they were exported by thousands in the frozen state to London, and were also extensively canned. Then the usual diminution, due chiefly, it would seem, to stoats and weasels, took place, and the birds disappeared from areas where they were at one time quite common. In Otago they were formerly abundant round Dunedin and on both sides of Otago Peninsula, but it is several years since they were seen there, and their extinction is attributed largely to poisoned grain and pollard. They are still numerous in many parts of both Islands, and are the most common of the introduced game birds. In some districts the farmers wage war against them with gun and poison, as they are said to be very destructive to young grass and clover seedlings.

8. Virginian Quail, Bob-white, or Colin (*Ortyx virginianus*).

This is the principal game bird of North America, where its native habitat is in the eastern United States from Massachusetts and Minnesota down to the Gulf States, and west to Dakota and Texas. It was introduced into New Zealand in 1898 and 1899, when several hundred (altogether over 1,100) birds were distributed over the country from Auckland to Southland. They were reported from various districts for a year or two, but by 1909 seemed to have completely disappeared. Recently

they have reappeared in the Auckland District, and the local Acclimatization Society is now distributing them through the Waikato country.

This is a slightly smaller bird than the Californian quail, its average length being about 8½ in. The top of the head is black, the tips of the feathers being chestnut; the back and sides of the neck are white, the mantle vinous red; a black band extends across the cheek from the gape to the ear-coverts, which are chestnut-coloured. The lower back and upper tail-coverts are olive-grey, mottled with black; wing-coverts reddish barred with black; the upper chest is reddish shading into buff in the lower part and white in the belly, all the feathers irregularly barred with black bands; the sides and flanks are chestnut, passing into white on the margins, the latter barred with black. An ocellated appearance is produced on the flanks by the last bar on each side being crescent-shaped; the tail-feathers are slate-coloured and mottled. The hen bird differs from the male in having the throat bright buff, while the black bands on the under-parts are much less distinct, and are usually absent in the middle of the breast and belly.

The bob-white rises from the ground with extraordinary velocity of movement, and has a most impetuous flight. It covers a great range in its search for food and cover. "When a young brood is startled the mother bird goes through all sorts of antics to distract the intruders, shamming lameness or a broken wing, until she thinks a safe distance has been reached, when she will rise and dart off with a loud whirr."

The nest is formed of a slight depression in the ground, lined with dry leaves and soft grasses. In this hollow from one to two dozen pure-white eggs are laid. These average 1¼ in. long by ⅞ in. broad, and they take between three and four weeks to hatch out. The male bird usually mates with only one hen and shares with her the work of incubation. In the southern United States two broods are commonly reared in each season, and they will probably do this in the mild climate of Auckland.

The old birds feed on seeds of various grasses and cereals, as well as of various weeds, and on berries; the chicks are fed chiefly on insects. In about a fortnight from hatching their little wings are sufficiently developed to enable them to fly. "At

nightfall the whole covey settles in some open place, and, huddling under a bush or a tussock, they form a little circle with their heads outwards, so that if disturbed they can spring and separate at a moment's notice."

9. Common Pigeon (*Columba livia*).

There does not seem to be any record of the first introduction of domestic pigeons into New Zealand, but we may be fairly certain that they were brought into the country in the very early days of European settlement. Neither do we know what kinds or breeds of these birds were originally introduced. But we can see now at every show of poultry, pigeons, and cage-birds a great variety of breeds differing in form, size, colour, and habits. No domesticated animal shows such variation from the original type as the common pigeon, and of no species is the origin more clearly and definitely established. All domestic pigeons are descended from the wild rock-pigeon (*Columba livia*), a species which is spread over northern Europe and Asia, and which extends as far south as the Indian Peninsula, with little variation. The birds of this species are not to be found on trees like our own fine large native pigeon, or the wild stock dove of Britain. They live and nest among rocks, and whenever our domestic pigeons go wild, as they have done all over the country, they do not take to the bush, but to rocky and precipitous hills and river-gorges.

Charles Darwin, whose work on the "Variation of Animals and Plants under Domestication" is a perfect mine of information on the subject, considered that there were more than one hundred and fifty races of domestic pigeons which bred true to kind. If these breeds had been found wild they would have been classified by naturalists under at least five genera (not species), including (1) pouters, (2) carriers and runts, (3) barbs, (4) fantails, and (5) short-beaked pigeons, such as turbits. The remaining domestic forms might have been included in a sixth genus with the wild rock-pigeon.

This latter bird, the parent form of these domestic races, is of a slaty-blue colour with black bars on the wings, and a white croup (or loins). The tail has a black bar close to the end, and the outer

webs of the outer tail-feathers are edged with white. In all the genus *Columba* the tail-feathers number twelve. The average size of the wild rock-pigeon is stated to be approximately as follows: length from tip of beak to end of tail, 15 in.; spread of wings from tip to tip, 27 in. to 28 in. The average weight, is 14 oz. Among domestic breeds all sorts of colours and combinations of colours are found. The length of a pouter is about 19 in., and its spread of wing 34½ in. The weight of a runt is about 34 oz., and of a short-faced tumbler about 6 oz. The standard number of feathers in the tail of a fantail is thirty-two, but they are said to go as high as forty-two. Yet with all this diversity of structure, size, weight, and colour there is a tendency in all races of domestic pigeons, both when purely bred, but more especially when intercrossed, to produce offspring of a blue colour, with the characteristic marks of *Columba livia*. This tendency to reversion or "throwing back" to the original wild stock is thus stated very clearly by Darwin: "When two birds belonging to distinct races are crossed, neither of which have, nor probably have had during many generations, a trace of blue in their plumage, or a trace of wing-bars and the other characteristic marks, they very frequently produce mongrel offspring of a blue colour, sometimes chequered, with black wing-bars, &c.; or if not of a blue colour, yet with the several characteristic marks more or less plainly developed."

Wild pigeons are very common in Otago in many rocky districts though they are unmercifully persecuted by pot-hunters. Frequently it is possible to recognize the race from which they are descended, but in other cases they are too mixed to do this. But in most the dark slate-blue colour prevails. Here is a note on one brought to me in 1916 from the Rock and Pillar Range in Otago: "Colour slaty-blue; black bars on the wings, but not well defined; black bar at the extremity of the tail, and the outer tail-feathers edged with white." Another, from Duntroon, inland from Oamaru, had "all the characteristic markings of the wild rock-pigeon." Still another from the same district: "Nearly black, tinged with slaty-grey on the neck, black tinged with brown on the wings, one distinct black bar on the wings, and a black bar on the tail."

Such wild birds are probably common in many parts, and especially on inaccessible cliffs throughout New Zealand.

Both the ring-dove (*Turtur risorius*) and the turtle-dove (*Turtur turtur*) are common cage-birds, which have been frequently imported into New Zealand by dealers during the last fifty years. In many cases they have been liberated round homesteads or in public parks and gardens. But it is doubtful if they ever become truly wild, and therefore I have not included them in this list of wild introduced birds.

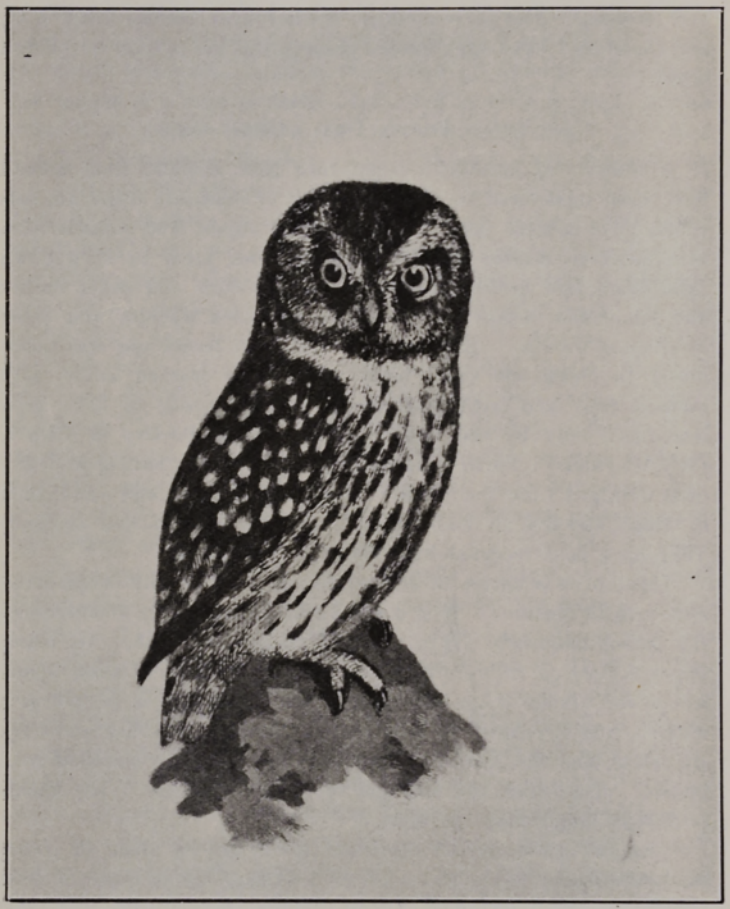
10. Small Brown Owl (*Athene noctua*).

A number of animals brought into New Zealand from abroad have been introduced in order to check or eradicate other animals which have become pests. Thus ferrets, stoats, and weasels were introduced to destroy rabbits; insectivorous birds to keep down caterpillars and grubs which were ruining corn and other crops; and ichneumon wasps and ladybirds to check aphides and other destructive insects. Quite recently the small brown owl was introduced to check the small birds which were playing havoc with orchard fruit and with grain crops. They appear to have been introduced only by the Otago Acclimatization Society in 1906–7, those liberated in North Canterbury and at Rotorua having probably been obtained from the south. They have become well established in Otago, and will no doubt spread into other parts of New Zealand. They have been reported from Hawera, in Taranaki.

The bird is a native of central Europe, and is only occasionally met with in Britain. It is a small bird, considerably smaller than the native morepork, 11½ in. being a maximum length. Its whole upper surface is brown in colour, mottled with oval white spots, which are triangular on the head. The brown tail is tipped with whitish, and is crossed by four whitish bands. The face and neck are white, and the rest of the under-surface is white streaked with brown. The irides, the bill, and the feet are yellow. The female is slightly larger than the male.

This owl is not strictly nocturnal, for it can fly about in strong sunlight without losing the sense of direction, but it becomes most vigilant towards evening. It also emits its plaintive note and monotonous cry not only at frequent intervals through the night, but also during the daytime. It nests in hollow trees, clay banks, and deserted rabbit-holes. The eggs are nearly spheroidal in shape, smooth and glossy, ranging from 1·3 in. to 1·4 in. in length by

1·0 in to 1·2 in. in breadth. The male bird takes his turn of sitting on the eggs during incubation. The young are reared on small birds, mice, frogs, beetles, moths, and caterpillars.



[*After Sharpe.*

FIG. 7.—THE SMALL BROWN OWL (*Athene noctua*).

Wherever these owls have become numerous they tend to scare away the small birds, and as Mr. Philpott, of the Cawthron Institute, puts it, "Where a pair of owls have established them-

selves, the evensong of the thrushes and blackbirds gives place to an incessant chorus of terrified alarm-notes." The small brown owl is not a forest-loving bird, but keeps to more open country, seeking for its food in plantations, along the hedgerows, and around buildings. There is no doubt, however, that along the outskirts of the bush it takes heavy toll of the few native birds which still occur in such parts, such as korimakos, fantails, and tomtits.

Wherever owls rest there are to be found pellets of refuse material consisting of the bones, feathers, fur, wing-cases of beetles, and other indigestible parts, which the birds eject from their mouths. From an examination of these it is possible to ascertain what the birds have been preying on.

11. The Skylark (*Alauda arvensis*).

Skylarks are so common in New Zealand, and so widely spread throughout the country, that unobservant people and young persons born in the Dominion are apt to think of them as indigenous birds. Yet they have been naturalized for only a little over half a century. They were introduced first by the Nelson Acclimatization Society in 1864, but every important society—Otago, Canterbury, Wellington, and Auckland—followed the example of Nelson and imported them by the hundred. The birds are easily carried and stand captivity well, so it was not a difficult matter to bring them overseas. In every part of the country they have increased rapidly and spread throughout the whole area, but they confine themselves to open country, and especially to cultivated land. Still, they have been found nesting in the Canterbury Alps to a height of 5,000 ft.

In this southern land the skylarks occasionally sing right through the winter, but it is usually in September, when they are nesting, that they begin to sing freely. As the old poet who wrote the Canticles sings, "Lo, the winter is past, the rain is over and gone; the flowers appear on the earth; the time of the singing of birds is come": which is true for New Zealand, except for the rain.

Macgillivray says of the skylark: "The song of the lark is certainly not musical, for its notes are not finely modulated, nor its tones mellow, but it is cheerful and cheering in the highest degree, and protracted beyond all comparison. In a sunny day in spring, when the grass fields have begun to resume their verdure, it is pleasant to listen to the merry songster that makes the welkin ring

with its sprightly notes. In the sultry months of summer still more pleasant is it to hear its matin hymn while the dew is yet on the corn; and in winter, should you chance to hear the well-known voice on high, it reminds you of the days that have gone, and fills you with anticipation of those that are to come. No doubt much of the pleasure derived from the lark's song depends upon association, and to him who finds delight in wandering over the green fields, along the daisied margin of the clear stream that winds in the bottom of the pastoral glen, or upon the ferny brae, where the

FIG. 8.—THE SKYLARK (*Alauda arvensis*). [*After Bonhote.*

'long yellow broom' and 'blossomed furze unprofitably gay' shoot up, the song of the lark imparts an elasticity to the mind, elevates the spirits, and suspends for a time the gnawing of corroding care. In confinement this birds sings every whit as well as when at large, and when rapidly perambulating the square bit of faded turf in its cage it enacts its part with apparently as much delight as when mounting towards 'heaven's gate.'" I do not agree with the writer in his last sentiment, for a song-bird in a cage, except it be a canary, which is an artificial bird of purely domestic habit, always saddens me as a thing against nature.

The lark has always been a favourite with the poets, and Macgillivray's last words are taken from the song in "Cymbeline":

Hark, hark! the lark at heaven's gate sings,
And Phoebus 'gins arise,
His steeds to water at those springs
On chaliced flowers that lies;
And winking marybuds begin
To ope their golden eyes:
With every thing that pretty bin,
My lady sweet, arise.

From the lines written by Milton in his younger days in "L'Allegro":

To hear the lark begin his flight,
And, singing, startle the dull night,
From his watch-tower in the skies,
Till the dappled dawn doth rise,

to the familiar song of the Ettrick Shepherd, beginning

Bird of the wilderness, blithesome and cumberless,
Sweet be thy matin o'er moorland and lea,

nearly all true Nature poets have sung of this bird. Two of the best-known poems are Shelley's famous ode—

Hail to thee, blythe spirit!
Bird thou never wert,
That from heaven or near it,
Pourest thy full heart,

and Wordsworth's well-known lines—

Up with me! up with me into the clouds!
For thy song, Lark, is strong;
Up with me! up with me into the clouds!
Singing, singing,
With all the heavens about thee ringing,
Lift me, guide me, till I find
That spot which seems so to thy mind!

But, "Alas! for the rarity of Christian charity under the sun," the only people who write about the skylark in New Zealand are the angry farmers, who count the damage to their crops, and naturally feel much aggrieved at the mischief the sweet songster does.

In summer the male skylarks begin to sing before sunrise and continue till after sunset. But the individual song is not continuous. The bird rises with quivering wings almost perpendicularly

from the ground, and then circles as it mounts, pouring out its song for about two minutes. As it descends, the song stops when near the ground, and the bird drops suddenly at some little distance from the nest. Sometimes the skylark sings from a bush or a post, and very occasionally it has been observed to sing even from the ground. When it sings from a stationary position it slightly moves the wings and swings the body from side to side, as if in imagination it was soaring skywards.

In sunny, dry weather skylarks may be seen scratching slight hollows in the soil, in which they dust their bodies, no doubt to get rid of any parasites which trouble them. In this respect they resemble the common native ground-lark, or pipit, a bird for which, however, they cannot be mistaken.

The skylark is slightly more than 7 in. in length; its wings are about 4½ in. long. The top of the head is brown, and the feathers on it form a decided and very distinctive crest. The whole upper part of the body is brown, each feather being dark along the shaft and becoming paler towards the margins, some of them being tipped with white. The outer feathers of the tail are broadly edged with white. The under-surface is pale yellowish-white; the throat and sides of the neck show some dark-brown elongated spots.

The nest is a slight hollow in the ground, usually formed simply of grass, with occasionally some hair, and both it and the contained eggs are so effectually concealed that they may often be walked on before they are discovered. The eggs are so thickly speckled with brown that the greenish-white ground-colour is obscured, the brown spots being mingled with the underlying grey ones. Very frequently the dark spots are congregated at the larger end of the egg, where they often form a ring. The eggs are rather less than 1 in. long by about 0·7 in. broad. The period of incubation is about fifteen days, and the first brood is usually hatched out in October. Generally two broods are produced each season.

Skylarks feed largely upon seeds, including most kind of grain, sometimes on small-fruits, and, when the young are being reared, on insects and worms. They are particularly fond of sprouting corn and seeds of turnips, clover, &c., and consequently are among the birds which the farmer persecutes without mercy. But in spite of all their enemies they continue to increase, and are among the most abundant birds of the open country.

12. The Song-thrush (*Turdus musicus*).

The song-thrush, or mavis as it is called in Scotland, though it has only been in the country for little more than half a century, is now one of the most abundant birds in many parts of New Zealand. It was first introduced into Nelson in 1862, but it disappeared entirely from that district, and those which were later on found there came from other parts. The Otago and Canterbury Acclimatization Societies brought in great numbers of birds in 1865, and Auckland followed later.

Though so common and well-known a bird as hardly to need description, yet if one were to hand a dead thrush to many town-dwellers it would be a surprise to notice how many would fail to recognize it. The bird is about 9 in. long. The back, wings, and tail are olive-brown; the chin white; the throat, sides of the neck, breast, and flanks yellowish, spotted with dark brown; the belly nearly white. The spotted breast is the most conspicuous feature of the bird's colouring. The under wing-coverts are of a rich golden hue in the male bird in spring-time. The legs and feet are pale brown. The eye is of a soft brown hue. The hen bird is smaller and lighter in colour than the cock.

Thrushes are mostly found among trees, shrubs, and hedgerows, and they seek their food on the ground. They do not penetrate the deep forests of this country, nor do they ascend the mountains to any great height. They fly with great vigour and rapidity, sometimes at a great height. On a quiet summer evening, when the sun has set and most of the light has faded out of the sky, so that birds can scarcely be seen, an occasional thrush may be observed overhead sailing away to its favourite haunt. Usually, however, they stay very much in one place, and the same birds appear year after year in the same glade or garden.

The thrush in New Zealand begins to sing early in May, and continues right on to January, after which its note is rarely heard. Its song is well known, but it is most difficult to describe, for different birds have very different notes and repetitions. It frequently sounds as if a distinct phrase was uttered, and was repeated again and again. The bird usually perches on the top-most branch of a tree when singing. Occasionally it sits on a post or a telegraph-wire, but usually the perch is an exalted and open

one. In the very height of the season a thrush will sing for the greater part of sixteen hours out of the twenty-four.

When feeding, the general mode of progression is by leaping on the ground, and it is interesting to stand and observe these birds as they hop over a lawn, and stop with the head on one side to watch for a worm or other object suitable for food. When the bird sees the end of a worm at the mouth of its hole it leaps quickly towards it, nips it in its beak, and pulls away till it gets it out. If it misses its catch it drums on the ground and picks at the earth in its attempts to get hold of its prey.

Where snails abound the thrush picks up the shell in its beak and knocks it repeatedly against a stone till it breaks it, so as to get at the mollusc within. On the seashore they frequently feed on whelks and periwinkles. Any one who has tried to break the shell of a whelk knows how hard and seemingly unbreakable it is, yet the thrush succeeds in doing it by a succession of smart blows repeated again and again. As the bird usually uses the same stone against which to break the whelks, it is not uncommon on a rocky seashore to find a heap of shells, the result of a long succession of such journeys.

As fruit begin to ripen on trees, bushes, and herbs the thrushes give up most of their insect and other animal food and devote themselves to a fruit diet. Then begins the time of ravage in the garden and in the orchard, and people forget all the good that the birds have done during the rest of the year. Before the introduction of thrushes and blackbirds fruit of all kinds could be grown in the open, but as the birds began to increase it became impossible to grow small-fruit especially without protection. Netting has had to be largely resorted to, while in large orchards owls, cats, crippled hawks and gulls, assisted by guns, have to be employed to destroy or scare away the depredators.

The effect produced by these birds on the native and introduced vegetation has been very marked, owing to their fruit-eating habits. The indigenous flora of New Zealand contains an exceptionally high proportion of plants with succulent fruits, which points to the fruit-eating proclivities of the native bird fauna. This proportion is approximately 16·55 per cent. of the whole. In Australia about 9 per cent. and in Britain 5 per cent. of the whole flora have succulent fruits. The introduction into New Zealand of more fruit-eating

[*After Bonhote.*

FIG. 9.—THE SONG-THRUSH (*Turdus musicus*).

birds, such as blackbirds and thrushes—which swallow them whole in the case of small-fruits, and so distribute the seeds, and in the case of large ones like plums and apricots carry them off to some distance where they can pick off the flesh and leave the stones—has led to a considerable increase in succulent-fruited plants. In such a wooded area as the Town Belt of Dunedin, in those parts where the native vegetation is protected from all grazing-animals, there has been a marked increase in the number of individual plants of *Fuchsia*, *Coprosma*, *Melicytus*, *Muehlenbeckia*, and other berry- and drupe-bearing genera. Along with these, various introduced plants, such as gooseberries, currants, raspberries, brambles, Cape fuchsias (*Leycesteria*), barberries, but, above all, elderberries (*Sambucus nigra*), have spread through the native vegetation. The last-named plant in particular threatens to crowd out everything else, and a considerable sum of money is spent each year in efforts to eradicate it. In many parts of New Zealand the blackberry and sweetbrier are most obnoxious pests, and thrushes and blackbirds are to a great extent responsible for their spread and increase.

Kerner von Marilaun has studied this question of the distribution of succulent-fruited plants, and much of what he has learned is of interest in this country. Thus in his work on "Flowers and their Unbidden Guests" he states that thrushes are made ill by eating *Phytolacca* berries. Apparently the statement was based on the case of one individual bird, which was unwell after eating some of the fruit, for it is repeated in his larger work on the "Natural History of Plants," where he states that a "song-thrush sickened after eating berries of *Phytolacca*." Now, this plant—the common inkweed, or pokeweed—is very abundant in the warmer parts of New Zealand, and thrushes eat the fruit freely. Kerner also states that when the fleshy fruits of barberry, privet, prickly pear, and laurustinus, all of which have seeds exceeding 5 mm. ($\frac{1}{5}$ in.) in diameter, were introduced into the crop of thrushes with other food the pulp passed into the gizzard, but all the seeds were thrown up. "The seeds of fleshy fruits which were greedily devoured were thrown out of the crop if the stones which they enclosed measured as much as 3 mm." Now, barberry is certainly spreading in many bush districts, and is distributed by thrushes and blackbirds.

Kerner also found that of the fruits and seeds which passed through the intestines of thrushes no fewer than 85 per cent.

germinated. In most cases the germination was retarded in comparison with seeds not so treated. But in the case of a few berries, such as barberries, gooseberries, and currants, it was hastened. The time taken by seeds to pass through the alimentary canal of a thrush was very short—half an hour in the case of the elderberry, and three-quarters of an hour with seeds of currants. The majority of seeds took from one and a half to three hours to perform the journey. Small smooth seeds of forget-me-not and some grasses were retained for the longest period.

The thrush in New Zealand builds the same kind of nest that its predecessors in Britain built. It is usually placed in a thick bush or a hedge, and is made of slender twigs, roots, grass, and moss, and always lined with a thin layer of mud or of cow-dung. It is a singularly hard and unyielding bed. The cavity is about 4 in. in diameter and rather less in depth, and in it are laid from four to six eggs. These are generally broadly oval in shape, about 1 in. long and only a little less in breadth, of a bright bluish-green colour, with roundish spots of dark purplish-brown or black, which are usually largest and most numerous at the broader end. The eggs are laid at the end of September or beginning of October, and the first fledglings appear at the end of that month. Usually two broods are reared during the season. Before the breeding season the cock birds often have savage fights, and it is not uncommon to see a pair sitting opposite each other, resting on their tails, with their bills gaping, and both utterly exhausted by the fierceness of their combat. At other times they can be seen in a regular rough-and-tumble scrimmage, falling over each other in their blind fury. They do not seem to do each other much harm, but no doubt the vanquished one knows when he has had enough, and he abandons the field—and the lady—to his stronger rival.

The power of flight of the thrush is very great. The bird has found its way to the Chatham Islands, a distance of about four hundred and fifty miles from New Zealand, and is now quite established there. It is also found on Sunday Island, in the Kermadec Group, fully six hundred miles from New Zealand.

There is a good deal of albinism among thrushes, and birds with more or less white in their plumage are not uncommon. In thickly populated districts such birds are apt to be marked, and do

not have a very happy time. They always seem to be wilder and more shy than normally coloured birds.

Thrushes and blackbirds occasionally pair together, though no hybrids appear to have been noticed in New Zealand. They certainly occasionally nest together, and Mr. Johannes Andersen has nests in which both kinds of eggs were laid and in which the birds appeared to sit turn and turn about.

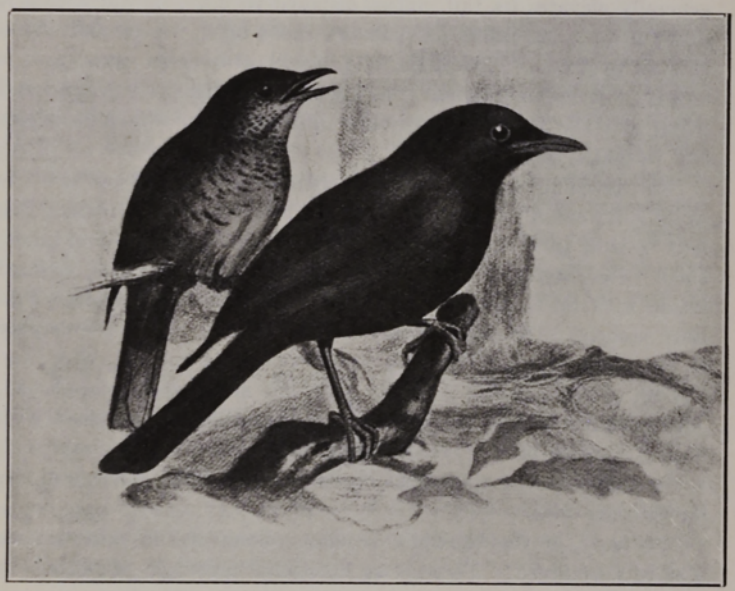
13. The Blackbird (*Turdus merula*).

The blackbird is most distinct in appearance from the thrush, and yet, except for the dark colour, there is scarcely any structural difference between the two species. The plumage of the male bird is glossy black, with bright orange-yellow bill, a ring of orange round the eye, and brownish-black legs. In spring the colours are particularly bright. The female is dusky brown, with the lower parts lighter, and with a few dark-coloured spots; the bill is dark brown. The full length is about 10 in.

Like the thrushes, the male blackbirds have most savage fights with one another, as any one watching them closely at the beginning of spring may see for himself. The male bird is a particularly noisy fellow, and when disturbed or alarmed raises a succession of shrill, clear, almost chuckling notes, as he raises his tail, flaps his wings, and hops along the ground preparatory to taking flight, which he does in the most excited manner. It is somewhat difficult to understand the object of all his noise, for, being such a conspicuous bird, it only serves to draw attention to his presence. If one watches a cat stalking a blackbird, the latter is seen to raise such a commotion when he catches sight of his enemy that the cat appears to be, and probably is, temporarily cowed. Under similar circumstances a thrush trusts to its brown and mottled colour as a protection, and gets away as quietly as possible. Thrushes are more frequently caught by cats than blackbirds are.

Blackbirds feed on worms, insects, grubs of all kinds, snails, seeds of various plants, including wheat and other cereal grains, and especially—in the season—on succulent fruits. Some naturalists consider that they are more responsible for the spread of succulent-fruited plants than thrushes. Kerner states that the blackbird is much less fastidious in regard to its food than the thrush. When fed in confinement it swallowed even poisonous fruits like those of

the yew, and never rejected a single fruit that was mixed with its food. Of the fruits and seeds which passed through the intestines 75 per cent. germinated. Macgillivray's account of a blackbird getting worms is worth reproducing. He says: "It is amusing to observe a blackbird searching for food on the smooth grass of a garden, which one may easily do from the window without being noticed. In December I watched one in order to note its motions. After looking quietly at a particular spot for some time it hopped



[*After Bonhote.*

FIG. 10.—THE BLACKBIRD (*Turdus merula*).

up, began to peck the ground with great energy, and after some exertion succeeded in dragging out a worm of moderate size, which it immediately threw on the ground. It then pecked at the worm for nearly a minute, and, beginning at one end, separated by a sudden stroke a small portion, which it swallowed. In this manner it proceeded until it had devoured the whole, not swallowing at any time more than a small fragment. It then hopped about, looking now and then at a certain spot, and at length began to dig vehemently

for another worm, which it soon procured. This was the first time I had closely watched a blackbird while searching for worms, but I have since had repeated opportunities of convincing myself that it always proceeds in the same manner, never swallowing an entire worm unless it happens to be extremely small, and cutting the very large ones into a great number of pieces. When searching for food it hops or leaps with great alacrity, keeping its tail a little raised and its wings loose; and when perched on a tree, twig, or wall it generally elevates its tail, unless disposed to doze, in which case it draws in its neck, ruffles its plumage, tucks up its wings, and allows the tail to droop. The flight of a blackbird over an open space is steady, without undulations; but along the hedges is wavering and fitful, and the bird suddenly darts into the place which it selects and instantly settles."

The breeding season in New Zealand begins sometimes as early as August, but it is usually September before nests are found. The nest is built in a hedge or small tree, and is constructed of roots, small twigs, stems of grass, lichens, and similar materials, covered inside with mud, and lined with finer materials. It is often skilfully hidden. The eggs, usually five in number, differ considerably in size and colour. They are from 1 in. to $1\frac{1}{4}$ in. long, and from 0·75 in. to 0·9 in. broad; mostly oval, but more rarely pear-shaped. The ground-colour is bluish-green or greenish-brown, marked with dots of reddish-brown, the markings being closer at the large end, where they sometimes form an obscure ring. The female bird sits for thirteen days.

The song of the blackbird is more sustained and mellow than that of the thrush. There is an occasional repetition of notes, but the melody is continuous, and the tone sweet. The bird seems to be jubilant in his singing, pouring forth a stream of song. Beginning in July or August, the note of the blackbird is heard continually till January, when it stops as a rule. Occasionally it may be heard again in late autumn. Sometimes, as Gilbert White tells us in one of his charming letters, the blackbird sings when flying from bush to bush.

The first attempt to naturalize the blackbird in New Zealand was made by the Nelson Acclimatization Society, which liberated twenty-six birds in 1862. Otago, Canterbury, and Auckland all followed suit, so that the species soon became common throughout

both Islands. It is rather singular that in the far north of Auckland, at Whangarei and farther north, blackbirds are rare or are altogether wanting, while thrushes are common.

Mr. Philpott, of the Cawthron Institute, states that, "unlike the thrush, the blackbird is to be found in the heart of the big forests." He says, "I have met with the bird wherever I have gone, and found it as common on the Hunter Mountains at 3,000 ft. elevation as in the bush near Invercargill. I have no record of the thrush occurring in alpine forests."

Blackbirds can hold their own against any other bird denizens of the forest; sometimes two or three of them will attack and even kill a tui. They have great powers of flight, and have found their way to both the Chatham and Kermadec Islands, as well as to the Auckland Islands, which are about 290 miles from the south end of Stewart Island. This occurrence is especially interesting, for the prevalent winds in the Southern Ocean would sadly impede the passage of a bird flying southwards. In Europe there are migratory races of thrushes and blackbirds, and it is quite possible that some of the birds introduced into New Zealand may have belonged to such races.

14. Hedge-sparrow (*Accentor modularis*).

The hedge-sparrow is now one of the commonest of introduced birds in the South Island of New Zealand, though it is still comparatively rare in the North, where it is spreading steadily. This is curious, because the Auckland Acclimatization Society liberated several birds in 1868, and continued to import them till 1875. In 1873 the first nests were observed there, and the birds were said to be well established, yet it is almost or quite unknown in the far North. Otago and Canterbury also liberated these birds in 1868, and in subsequent years.

The hedge-sparrow is a very popular bird with all who know it. No bad habits are recorded against it. Its quiet, timid ways and very modest colouring cause it to be overlooked by non-observant people—that is, by the majority of persons.

While it has a superficial resemblance to the common sparrow, it is not related to it, except very remotely. The sparrow belongs to the family of finches, while the hedge-sparrow, or hedge-accentor as it is sometimes called, is a sort of dwarf thrush, a relationship

borne out to some extent by the occurrence of spotted plumage in the young. In many parts of England the hedge-sparrow is known by the distinctive but ugly name of dunnock.

This is a smaller and slighter bird than the common sparrow, the male being only about 5½ in. long. The back is brown slightly streaked with black; the head, neck, and breast show a bluish-grey coloration more or less streaked with brown; the under-parts are paler; the legs and toes are orange-brown, with black claws. The female is slightly duller in colour than the male, but is otherwise undistinguishable.

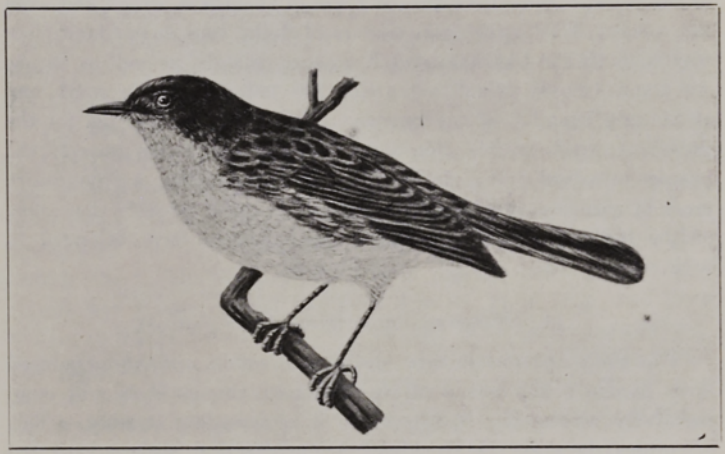


FIG. 11.—THE HEDGE-SPARROW (*Accentor modularis*).

(The figure does not illustrate the nearly uniform brown colour of the plumage.)

The song is very sweet and plaintive, though rather monotonous. It is occasionally heard in early winter, but the bird begins to sing regularly in August, and is heard throughout the summer, only stopping during the moulting season, which is about February.

Nesting begins in September. The nest is a neat little structure of small twigs and grass, lined with moss or any other soft material which is available. The eggs are usually four or five in number. They are oval, with the smaller end rather sharply pointed; about 0·7 in. to 0·8 in. long by 0·5 in. to 0·65 in. broad. The colour is a beautiful greenish-blue, without any spots. Incubation lasts ten days, and there are usually two broods in a year.

The hedge-sparrow feeds almost exclusively on insects, and it has no destructive habits. Some County Councils in New Zealand rather foolishly offer a reward for the eggs. There is no excuse for this ignorance, for the bird is too useful to be destroyed, and no boy would wantonly collect the eggs unless a price was offered for them.

15. Australian Magpie (*Gymnorhina leuconota*).

The Australian magpie is not a magpie at all, for the latter bird belongs to the Corvidae, or crow family, while the former is a member of the Laniidae, or shrikes. It is, however, very like the old familiar magpie of Britain in its clear black-and-white plumage. In Australia the bird is sometimes called the white-backed crow-shrike. It is a native of South Australia, Victoria, New South Wales, and Tasmania, from which latter country it was chiefly imported into New Zealand.

The earliest importations were made by the Canterbury Acclimatization Society from Victoria in 1864. Sir George Grey also introduced them at an early date into the Island of Kawau, where they quickly became very numerous and spread to the North Auckland district. Later on the Otago, Auckland, and Wellington Societies imported large numbers of these birds.

The Australian magpie is a striking-looking bird. The back of the neck, back, upper and under tail-coverts, and the base of the tail-feathers are pure-white; the remainder of the plumage and the shafts of the white portion of the tail-feathers are glossy black. The eyes are light hazel; the bill is bluish-lilac, passing into black at the tip, and the legs and feet are blackish-grey. The length of the male bird is about 17 in.

The nest is usually built on tall trees, as much as 50 ft. or more from the ground, and is constructed of dried sticks, and lined with grasses or other pliable material. It is usually a shallow structure about a foot in diameter and perhaps 3 in. deep. In this three or four eggs are laid, and these are over 1½ in. long by 1 in. broad. The ground-colour of the eggs is light brown, light green, or dull bluish-white, with zigzag streaks and blotches of chestnut or reddish-brown. The nesting season in the South Island is from September to November.

The magpie feeds upon everything that creeps or crawls on the ground, and is very destructive to insect-life. Very occasionally it eats grain and fruit, and when hard-pushed for food has been known to eat germinating corn. During a mouse plague in Victoria in 1905 magpies were observed to follow the ploughs in flocks of one hundred and fifty to two hundred, and to swallow every mouse that was ploughed up. As a rule, they feed chiefly on grubs, fly-larvae, and other forms of insect-life, and should therefore be rigidly protected.

Magpies are great fighters, and at the nesting season especially will attack any living thing, from a hawk to a man, which approaches the neighbourhood of their nest. They have been known to swoop down from high trees on the heads of a picnic party, and to give various members of it sharp blows. "These birds will never fly at you if you are looking at them, and if you turn round suddenly and face them when they are coming at you they will swerve off, and settle in a neighbouring tree to watch for an opportunity." They often attack and destroy other birds, especially small species like fantails. Three or four have been known to attack and kill a pheasant; and Mr. T. H. Potts records how this bird defended itself against the native quail-hawk (*Falco novae-zealandiae*) by throwing itself on its back, striking out with its beak and claws, and shrieking most wildly.

Both the male and female of this species are beautiful songsters. They have a fine flute-like song, which commences an hour or more before sunrise. They also occasionally sing during mild moonlight nights. In confinement they often prove to be very clever mimics. The writer knew of one bird which could bark like a dog and mew like a cat, but whose favourite amusement was to sit on a fence and call the fowls together for food which was not forthcoming. The strange thing was that the fowls were gulled several times a day, and yet apparently never learned to distinguish between the call of the food-supplier and the imitating bird.

Campbell, in his book on Australian birds, describes a tame magpie called Pattie, which built its nest in a bedroom of the house it lived in, and laid three eggs. He says she took "three weeks over the building of her nest. She commenced by bringing sticks, wire, and other materials from the yard, and finished

FIG. 12.—THE AUSTRALIAN MAGPIE (*Gymnorhina leuconota*).

by lining the nest with hair plucked from a large rug. Although Pattie sits steadily, she evidently entertains doubts about rearing her family, because she is always calling 'There's nae luck about the hoose when our guid man's awa.'" Campbell does not say whether the eggs were hatched or not.

Another Australian observer says: "The wooing of these birds generally commences in pursuit, and culminates in a pitched battle between the amorous parties on the ground. They tumble over and over, and go at it with beak and claw, screaming all the while, a lot of old birds of both sexes pretending to assist. When the fracas is ended the usual solo and chorus are given, after which the married couple fly off together. The union, I think, is lifelong with some of the birds, because one frequently sees an old pair together in one locality sticking to each other in and out of season, and for years using the same tree to nest in."

These birds are fairly common in the North Island from Wellington to Whangarei. In the South Island they are particularly common in North Canterbury, also in the district to the north of Timaru, but are not found south of the Waitaki, though fifty years ago they were breeding in the neighbourhood of Dunedin.

16. The Rook (*Corvus frugilegus*).

The rook is the only kind of crow which has been naturalized in New Zealand. Nelson was the first district in which they were introduced, three having been liberated there in 1862. Canterbury imported some soon after, and then Auckland liberated a number in 1869 and 1870. Those from the latter district spread south and over into Hawke's Bay. Then the Canterbury Society brought in a number more in 1871 and 1875. These appear to be all the importations. At the present time it would seem the birds occur in only two localities—viz., in parts of Hawke's Bay, and a few about Riccarton, south of Christchurch. It is difficult to say why they have not increased and spread, but it may be that the farmer's prejudice against them in the Homeland has followed them here, and they are destroyed as vermin.

The rook is a fairly large bird, from 18 in. to 21 in. long. Its plumage is of a uniform deep glossy black with a purplish-blue

[*After Bonhote.*

FIG. 13.—THE ROOK (*Corvus frugilegus*).

sheen on the upper parts. The beak is black, but at its base there is a bare patch of white skin, which appears to be due to the destruction of the feather-follicles by continual digging in the ground. The female rook is usually about 2 in. shorter than the male, and its plumage is less brilliant.

Rooks are eminently gregarious and sociable birds, joining themselves into communities, which are nearly always associated with the dwellings of man. Their breeding-places are known as "rookeries," a name applied nowadays rather vaguely to other congregations of birds, such as shags, or even to other animals, as seals. To speak of a seal "rookery" seems rather absurd, but the term is thoroughly understood now. Even crowded congregations of human beings in slum areas are sometimes known as "rookeries," especially if they have evil associations and defective hygienic arrangements. This is an unconscious testimony to the trickiness and thieving propensities of rooks, as well as to their habit of crowding together.

A real rookery in spring-time is a pleasantly noisy place. The birds return year after year to the same clump of trees, near the tops of which they build—usually in August and September—a somewhat substantial nest of sticks and small twigs, with an inner foundation of mud, and warmly lined with straw, grass, roots, wool, or other soft material. The nests are never less than 20 ft. to 30 ft. from the ground, and are so firmly built that they will withstand a great deal of rough weather. Even a gale will seldom dislodge them, though it is no uncommon thing for the young to be blown out. The eggs are from three to five in number, and are spotted and blotched with greenish-brown on a bluish-green ground. They measure 1·6 in. long by 1·15 in. broad. As soon as the young birds can fly the rookery is deserted, and old and young together fly in flocks to the fields and arable lands, where they wander about digging deeply in the ground for grubs of various kinds. On the approach of evening they draw off together to a plantation or clump of trees, which they use as a regular roosting-place. They have a heavy and laboured flight, but fly at a considerable pace, and can cover a good deal of ground. Their only note is a continual "caw, caw, caw," which, however, is rather pleasing than otherwise, just because it is homely and sociable.

The food of the rook is a subject of much interest to farmers, who are their principal enemies. That they eat an enormous quantity of insect-life is apparent to all who watch them. On the other hand, they very frequently attack and dig up potatoes in the fields, they can strip a walnut-tree of its crop in marvellously short time, and they destroy numbers of eggs of small birds, especially those which nest in open situations, such as the skylark. The latter is, of course, a recommendation to the farmer. In one set of observations made in Scotland on 355 birds it was found that 58 per cent. of the food consisted of cereal grains; 23 per cent. of insects, &c.; 7 per cent. of roots; and 12 per cent. miscellaneous. In another set 631 birds were examined. In these the food in 71 per cent. consisted of grain, seeds, fruits, roots, and miscellaneous vegetable matter; 15 per cent. of insects of various kinds and millipedes; 10½ per cent. of earthworms; and 3½ per cent. of miscellaneous animal food (eggs, young birds, field-mice, &c.). Unfortunately, the time of year when these examinations were made is not stated. Still, the record generally is against the bird. Professor McAlpine says of him, "He is a cunning rogue."

To sum up the case for and against the rook, it may be said that he eats the grubs of beetles, wireworms, larvae of crane-flies or daddy-long-legs, and grass-grubs generally; in the early morning, when dew is on the grass, he feeds on worms and slugs, and when he pulls up grass it is generally tufts with grubs at their roots; and he also destroys numbers of caterpillars. But when grain is newly sown, or when ripe corn is either drying in stooks or is laid, and when the potato crop is nearly ripe in the drills, he does an immense amount of damage. And he is such a knowing bird that he ignores most of the scares which the farmer sets up in his fields. But he has a wholesome dread of a man with a gun.

17. The Starling (*Sturnus vulgaris*).

Probably the starling is the most abundant bird in New Zealand, yet a little more than half a century ago there were none in the country. The Nelson Acclimatization Society liberated the first introduced birds in 1862, while most of the other societies imported numbers of them in 1867 and succeeding years.

The starling is about the size of a thrush—that is, from 8 in. to 8½ in. long; but the tail is shorter. To see a starling on a lawn,

especially in winter-time, one would say it was a dull-black colour; but even in winter its coat is glossy, and is shot with iridescent and metallic shades of bronze, green, and purple. At this season of the year, too, the feathers have got whitish tips, which rather obscure the bright plumage; but as spring approaches these feathers drop off, and leave the burnished colour in full perfection. In the breeding season the starling is a beautiful bird, and the bill, which was blackish in winter, turns to a bright lemon-yellow colour. Starlings resemble crows in one point: they do not hop about the ground like thrushes or sparrows, but walk about sedately, unless they are in a hurry, when they run. They are strong flyers, having well-developed wings, which are fully 5 in. long; but their most interesting feature in flight is shown when they congregate into large flocks, especially in autumn. "The extraordinary precision with which the crowd, often numbering several hundreds, not to say thousands, of birds, wheels, closes, opens out again, rises and descends, as if the whole body were a single living thing—all these movements being executed without a note or cry being uttered—must be seen to be appreciated, and may be seen repeatedly with pleasure."

Starlings nearly always select some kind of a hole for a nesting-place; it may be under the eaves of a roof, in a drainpipe, on some tall building, in a tree, or on the face of a cliff. One correspondent wrote to the author as follows: "When I arrived in Napier from England in 1875 there were only four starlings in the town. They increased rapidly, and took possession of the limestone bluff that looks out over the bay, boring into the softer veins of the limestone. After eleven years they were in hundreds of thousands. Within recent years they have largely disappeared from the neighbourhood, and it has been suggested that this is due to the fact that numbers of pigeons which had gone wild had established themselves along with the starlings on the limestone cliffs. The pigeons, which were also very numerous, attracted great numbers of harrier-hawks, which sadly reduced their numbers, and drove most of them away. Starlings are not commonly chased and caught by the hawks, but when in association with the pigeons they probably suffered along with them."

Out in the open and away from buildings the most frequently selected place for a starling's nest is a hole in a tree. In districts

[*After Bonhote.*

FIG. 14.—THE STARLING (*Sturnus vulgaris*).

where the original bush has been cleared of large timber they build among shrubs like ivy and the native *Muehlenbeckia*, while in some bare country they have even been found nesting among tussocks. The nest is generally a somewhat rough structure, made of straw or grass, with sometimes a few feathers or other soft material for lining. In this from four to seven eggs of a uniform pale-blue colour are laid; these measure 1·2 in. long by 0·85 in. broad. Usually two broods of young are reared each year. As the young grow they become very noisy, and as their parents are equally noisy the fact that a family of starlings is being reared is advertised to the whole neighbourhood.

For a great part of the year the food of the starling is mainly composed of insects, and the bird not only picks up all sorts of living organisms from the ground, but it is fond of sitting on the backs of sheep and cattle and picking off the ticks or other vermin which occasionally infest these animals. Hence no bird is more generally appreciated by the farmer or the pastoralist. An examination of the food of these birds, made in Scotland and carried on throughout the whole year, showed that grubs and insects constituted 70 per cent.; grain, 22 per cent.; the remainder being of a miscellaneous character. Sir Herbert Maxwell, in his "Memories of the Months," says that "two dozen young starlings shot on Brydon Marsh had their gizzards crammed with a mass of matted stuff, which on separating resolved itself into scores of legs of the daddy-long-legs (*Tipula*). Every female among the swarms of Tipulae would, if spared, have become the parent of a brood of leather-grubs, than which there is not a more destructive pest on arable or pasture land." The daddy-long-legs, or crane-fly, lives for three years underground, devouring the roots of grasses and other valuable plants. In some districts starlings follow the plough—usually at a considerable distance—for the grubs which are turned up. They have been reported as catching humble-bees and carrying them off to their nests. This is not, however, a common habit.

During the season starlings feed freely on many kinds of ripe fruit, both of introduced and native kinds. Some people imagine that this is a habit which has been acquired only in New Zealand, but this is quite a mistaken idea. In Britain the starlings feed not only on small-fruits, but also on plums, cherries, pears, and peaches. There is a well-known passage in Rabelais' "Gargantua" (written

about 1532) which states that "at this season the shepherds were withdrawn from the hills in order to keep the starlings off the grapes." In this country they have been found to eat pears, elderberries, and currants among introduced kinds of fruits, and the fruit of the cabbage-tree, broadleaf, white-pine, matai, rimu, miro, fuchsia, and makomako (*Aristotelia racemosa*), as well as of other indigenous shrubs and trees.

One result of the vast increase of starlings throughout the country—a result partly brought about also by smaller introduced birds—has been to eat out the insect food to such an extent as to nearly exterminate game birds. The disappearance of pheasants, partridges, quail, and wild turkeys is probably due more to the scarcity of ground insects than to any other cause.

The starling is a very engaging bird, and is fond of sitting on the ridge of a house or on a chimney-stack, chattering to its mate, or imitating the call of other birds. They not infrequently mimic the call of the Californian quail and the Australian magpie. They seem to treasure up the songs of other birds heard throughout the summer, and to try to reproduce them at other seasons of the year. A very common note is a peculiar clicking sound, as if two pieces of metal were knocked together. In confinement—and they are common cage-birds in many a cottage home—they become very tame, and can be taught to sing well and to imitate various sounds.

18. Indian Mynah (*Acridotheres tristis*).

These noisy, garrulous birds were introduced mostly from Australia, into which they were originally imported from India. They were brought in freely about 1870, and were breeding in Dunedin, Christchurch, and Nelson in 1871 and subsequent years. In later years the Otago, Canterbury, and Wellington Acclimatization Societies introduced large numbers of them from Australia. There is little doubt that all these birds were Indian mynahs which had become naturalized in Australia. The mere fact that great numbers were brought in—by scores and hundreds at a time—points to this. An experienced bird-catcher would have no difficulty in catching Indian mynahs by the hundred in the outskirts of Melbourne, where they abound.

One of the most remarkable things about the mynahs is their increase after their first introduction, then their subsequent diminution, and, in many districts, their ultimate disappearance. They used to build in the southern towns already named, but have not been seen in the South Island for about thirty years. They were at one time common in Wellington City, but have quite disappeared from there, though met with farther north. They are still common in Taranaki and parts of Hawke's Bay. Their disappearance is apparently due, either directly or indirectly, to the starlings, the increase of the latter birds coinciding with the decrease of the mynahs.

The mynah is a stoutly built bird, about 9½ in. long, or rather larger than the thrush. The general colour of the upper part of the body is brown with an ashy shade; the primary wing-coverts are pure-white; the tail-feathers are blackish-green, tipped with white. The head is greenish-black, the chest dark ash-coloured, the sides of the body brown shaded with ash, the belly and under tail-coverts white; the legs are yellow. The male and female birds are very much alike. It is a conspicuous and easily recognized species.

Mynahs are very domestic birds, and greatly affect the habitations of men and their immediate neighbourhood. Their usual breeding season is from November to February, and they commonly rear two broods. They build in roofs of buildings, holes in walls, or in trees. The nest is a shapeless but warm lining to the hole, composed chiefly of straw and feathers, with fine twigs, bits of cotton, strips of rag, old rope, and all kinds of odds and ends. In this from four to five eggs are laid. These are about 1·2 in. long by 0·85 in. broad, either long-oval or pear-shaped, brilliantly glossy, and varying from very pale blue to pure sky- or greenish-blue, and without spots. While the female bird is sitting, the male often struts about, bowing and swelling like a small dove, and screeching out his somewhat harsh love-song.

The mynahs, like the starlings, walk on the ground, and do not hop like a thrush. They sometimes follow the plough, and pick up abundance of grubs. They further resemble starlings in being mainly insectivorous, but they are also fond of fruit, attacking peaches, apricots, apples, pears, strawberries, and gooseberries. They are also credited with spreading the bramble and blackberry, but the evidence to this effect is not very convincing.

[*J. McDonald, photo.*

FIG. 15.—THE INDIAN MYNAH (*Acridotheres tristis*).

19. The Common Sparrow (*Passer domesticus*).

Because they are such familiar, commonplace, and somewhat unattractive birds we look on the sparrows with little affection and less sympathy. They are noisy, clamorous, impudent little fellows. "Pert as a cock sparrow" is almost a proverbial expression. They are regarded more as a nuisance than anything else. They fill the available spaces round the house with their untidy nests, choking the channels, and causing a mess both without and within. They steal the fowls' food, disbud the gooseberry bushes, pick the primrose blossons to pieces as they open, destroy the early peas as they come through the ground, eat the small fruit as it ripens, and generally cause the gardener to utter maledictions on their uncaring heads. Farther afield they eat the young grain as it ripens in the ear, and strip the farmer's crops before he can harvest them. They are quarrelsome, pugnacious creatures, charged with half the crimes in the calendar, and no one wastes any sentiment on them. Poets have sung the praises of the nightingale, the skylark, and the robin redbreast, but who can utter rhapsodies on the sparrow? Yet with all this catalogue of offences and delinquencies brought against them we have a sneaking fondness for the little rascals.

The sparrow is never found far away from human habitation; he has developed his peculiar characters—such as they are—in association with man. The evil that he does is very manifest; the good is not so much in evidence—it "is oft interred with his bones." He eats an enormous amount of insect-life, especially when young broods are being fed, and thus materially helps the gardener and the farmer, who are often his bitterest enemies. All through the winter when the fields are bare his food consists largely of seeds of weeds, together with all the caterpillars and grubs which he can find.

There were no sparrows in New Zealand till 1862 or 1864 (the exact date is doubtful), when one sparrow was landed in Nelson, the sole survivor of a considerable number shipped. But so anxious were the early settlers to have them that they offered bonuses for their introduction. Thus in 1864 the Canterbury Acclimatization Society offered 15s. for each pair landed; while the Auckland Provincial Government advertised for them at 30s. per pair. In 1867 five birds were liberated in Canterbury, and forty-seven in Auckland; other districts followed suit, and shortly they were to be found in all the centres of population in the country. Wherever

man has fixed his abode, there the sparrows are to be found also; but they never build their nests in waste places away from the haunts of men. After the birds were once firmly established neither individuals nor societies were anxious to accept responsibility for having introduced them, yet nearly all the acclimatization societies took a hand. They introduced them in all good faith, and congratulated themselves on the success of their efforts. It was only after the bad points in their character began to be manifested that they wanted to repudiate all responsibility. Here are two examples: The annual report of the Canterbury Society for 1889 contains the following statement under the heading "The Sparrow": "We most deliberately deny ordering or introducing this questionable bird, but we well remember the devastations made by the caterpillars and grubs previous to their advent." Yet in 1864 the society offered a premium for them, and in 1867 imported and liberated forty birds. In Auckland the society not only directly brought them out, but they also offered a price for them in 1864. Mr. T. B. Hill, who was a member of the Council says: "It was the Auckland Society that introduced them. With many other birds they were sold by Mr. S. Jones at his auction-mart, and the house-sparrow was the favourite. I was, I think, the largest purchaser at £1 per pair, and I successfully acclimatized them to my building, with Mr. Soppet's flour-mill adjoining, in Freeman's Bay, and soon had all the sparrows others had bought, down in my yard and flying in and out of the window of my room, where I kept several confined. I had people come to me for birds to replace what they had lost at the price I paid for mine. The first breeding season they proved a great nuisance in filling the spouting and other places in the bay with their nests. So many of us were not yet acclimatized ourselves that when we woke in the morning hearing the little 'Cheer-up, cheer-up,' it made us fancy we were back in the Old Country again. I certainly sent them to my friends in the country who were anxious to get them." This interesting quotation serves to show the feelings which were uppermost in the minds of the early settlers of this country, who wanted to reproduce the things and the conditions which had interested them in the Home-land of their youth.

Sparrows in New Zealand begin to nest early in spring, the first brood appearing in September, and the last in April. Probably

as many as five broods are reared in one season. From five to seven eggs are laid. Every boy is familiar with these eggs. They vary in size, but average 0·9 in. long by 0·6 in. broad. The general colour is light grey or greyish-white, spotted and streaked with dark grey or brown. Incubation lasts thirteen days. The young are fed in the nest for eight or nine days, then return to it for two or three nights, and afterwards shift for themselves. Mr. T. W. Kirk, who has studied the life-history of this species in New Zealand, found in five instances fresh eggs in the nest along with young birds, and he thinks that the young birds do the chief work of incubation of succeeding broods. In at least one instance marked birds reared in September were themselves breeding at the end of March. Calculating from nests which were watched, Mr. Kirk thinks that the average annual increase is five broods of six each, and this is a low estimate. Allowing for deaths at the rate of one-third of the whole annual increase, then one pair will produce 11 pairs at the end of the first year, 121 pairs at the end of the second year, 1,131 pairs at the end of the third, 14,641 pairs at the end of the fourth, and 161,051 pairs, or an actual increase of 322,100 birds, in five years, without taking into account (1) the early broods which are themselves breeding, (2) the fact that more than five broods are probably produced in a year, and (3) that often more than six eggs are produced at a time.

Sparrows have several enemies besides poisoned grain, cats, and small boys. The introduced owls, native hawks, kingfishers, long-tailed cuckoos, and shining cuckoos are all credited with catching and destroying these birds. But still they thrive and increase.

There are some slight differences in sparrows in different parts of New Zealand. Thus those found in and about Wellington are distinctly darker in colour than those which occur in Canterbury and Otago. They have evidently been brought from different localities in the Old Country.

20. The Chaffinch (*Fringilla coelebs*).

The chaffinch is a very familiar bird in New Zealand to-day, and those who were responsible for its introduction were evidently determined to have it naturalized, for it was introduced by the score. Nelson first brought out the birds to this country between 1862 and 1864, and later Canterbury, Auckland, Otago, and Wellington

FIG. 16.—THE CHAFFINCH (*Fringilla coelebs*). [*After Bonhote.*

followed. Though the birds are now very abundant, especially in the North, they did not always succeed in establishing themselves. For the first few years after their introduction into Otago they became fairly common, and then nearly disappeared altogether. They probably fed on the poisoned grain put down for rabbits, and it is only within the last twenty years that they have begun to come back. So in the South it is quite surprising to observe how few people know the chaffinch. It is now quite a common thing in the Town Belt and suburban streets of Dunedin to see one or more chaffinches along with the sparrows, but a glance at the marked colouring and the mode of flight enables any one with half an eye to recognize the differences. The chaffinch is a much more wary and shy bird than the sparrow; it lights down more quickly, and springs from the ground with more alacrity than its more humbly-coloured associates, and flies more strongly.

The male bird is from 6 in. to 6½ in long, and is readily recognized by the reddish-chestnut colour of the back and the transverse bars of white on the wings. The general coloration of the bird is thus described by Morris: "The forehead is black; the sides of the head dull pink, with a tinge of rufous; the crown, sides of the neck, and nape a fine bluish-lead colour; the chin, throat, and breast in the upper part dull pink, the lower part fading off into dull white, with a tinge of rufous; the back chestnut-brown; the wing-coverts black at the base, with a conspicuous white bar; the lesser wing-coverts bluish lead-colour, with another conspicuous bar; the tail-feathers lead-coloured."

The breeding season is chiefly in September and October. The chaffinch builds a neat little cup-shaped nest made of moss, lichens, grass, or a few twigs, and lined with feathers, hair, wool, or any other suitable material. In localities where lichens are scarce paper is sometimes employed instead. The nest is usually placed in the fork of a branch of a tree, but sometimes among the twigs of a hedgerow or among ivy. The outside is often covered with lichens or cobwebs, causing it to resemble the bark of the tree on which it is built, so that it is often difficult to detect it. When a person approaches the nest the birds manifest much anxiety, flying about or hopping among the twigs, and repeating their ordinary "tweet" in a hurried manner. The female sits very close, and from her colour and that of the nest is seldom perceived, but when aware

that she has been discovered she slips off with alacrity, and joins the male in evincing her anxiety as to the result of the intrusion. The eggs are from four to six in number; their average length is 0·8 in., and the breadth 0·57 in. They vary considerably in colour, but usually are of a pale dull bluish-green colour, clouded with dull red or purple, and streaked and spotted over the whole surface with red. The female bird sits for about eleven days.

The chaffinch has a short, mellow song, which is first heard as early as August with us. At Home it is one of the harbingers of spring. The commonest call is like "twink, twink," followed by "tweet, tweet, tweet." It is a very distinctive note, and one which is easily remembered.

The chaffinch feeds on grain and various kinds of seeds and other vegetable matters, but it also accounts for a great number of insects. During the nesting-period the young birds are fed exclusively on caterpillars, and a pair of birds which were watched were seen to feed their young thirty-five times in an hour. Yet, like the sparrow, this species is not looked upon with favour by either farmers or gardeners, and is certainly not included among those birds which are favourable to agriculture.

In the Southland forest districts, where this bird is common, Mr. A. Philpott reports it as especially abundant on the upper limits of the bush—that is, about 3,000 ft. elevation.

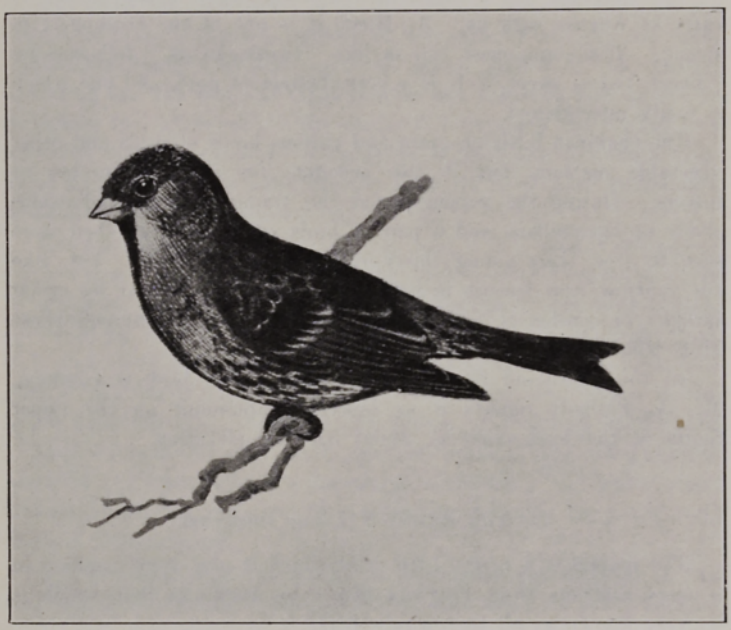
21. The Redpoll (*Linota rufescens*).

The redpoll is a pretty little bird which is now very common in country districts from Foveaux Strait to Auckland, but which is scarcely known at all to town-dwellers.

Nelson was the first locality to which the species was introduced from the Old Country, in 1862, but only two birds were landed. The Otago, Canterbury, and Auckland Acclimatization Societies followed with larger importations in succeeding years between 1868 and 1872. In every case the birds apparently disappeared soon after liberation, migrating to higher and more open country, where they quickly established themselves and increased greatly. Bird-catchers have taken as many as five hundred in a day in Southland, and they are equally abundant in Otago and Canterbury, and along the west coast of the North Island from Wellington to Taranaki. They are

probably common in both Islands throughout all the open country up to or slightly exceeding 3,000 ft. elevation.

This is a small bird, the male being not more than 4½ in. in length. The name is derived from the colour of the forehead, which is dull red in winter, changing to a deep crimson in summer, and edged by a brown or blackish-brown band. The breast in summer is a fine carmine-red, fainter below, and streaked with



[*After Sharpe.*

FIG. 17.—THE REDPOLL (*Linota rufescens*).

brown. The back is yellowish-brown, streaked with darker colour; over the tail it is greyish, and more or less tinged with red. The wings are brown, crossed with two pale-yellowish or whitish-brown bands; the tail is brown. The female in summer is more nearly the colour of the male in winter.

Redpolls have a light, nimble, and buoyant flight. They gather in great flocks in winter-time, and can then be taken by bird-

catchers in great numbers, especially on or near the coastal sandhills. These flocks break up on the approach of spring, and as the breeding season draws near their song is frequently heard, the clear, loud notes becoming increasingly sweet and pleasant as the season advances.

They begin to nest early in September. The nests are usually placed in a low bush or small tree, sometimes as high as 7 ft. or 8 ft., but more commonly nearer the ground. They are neat, well-built, and cup-shaped, and are composed of various materials, such as moss, stems of grass, hair, wool, feathers, &c. The pale bluish-green eggs vary from four to six in number; they are spotted with orange-brown, principally towards the larger end, with sometimes a few dark streaks. They are about 0·63 in. long by 0·48 in. broad.

These little birds feed mainly on small seeds, such as those of the wild turnip, dandelion, groundsel, and no doubt many others which have not been recorded; they also pick the young buds of several trees, and eat moss and other vegetable matter. During some summers they eat quantities of the turnip-aphis or green-fly; while during grass-seed harvest they subsist mainly on seeds of grasses. On the coastal sandhills they have been seen in large flocks, feeding on the seed of the toetoe-grass (*Arundo conspicua*), as well as on the seeds of rushes (*Juncus*) and other plants of the seashore.

The redpoll is easily tamed, and makes an engaging little pet.

22. The Linnet (*Linota cannabina*).

The linnet, variously known in Britain as the red, the grey, or the brown linnet, according to the seasonal colouring of the male birds, was first introduced into Nelson in 1862, and then into other leading acclimatization districts between 1865 and 1875. The birds were common for a short time and then completely disappeared, and a possible explanation is that the majority of them belonged to migratory varieties, which were thus lost; for in Britain, though the species is found all the year round, it is generally recognized that a very large proportion of the birds which spend the summer there arrive from the south in spring and leave again in autumn.

But some of those introduced into New Zealand must have survived and increased, for within the last few years they have

been recognized by very competent observers, while the nests and eggs were known here before ever the birds themselves were seen. They have now been recorded from Westland in the South Island, and from north of Wellington to the neighbourhood of Wanganui. Probably they are much more common than the records would seem to show, for "they are shy birds, rather less sociable and much less noisy than redpolls, and are more easily overlooked than most other species of small birds."

Except during the breeding season linnets usually move about in flocks. Their food consists largely of small seeds, such as those of wild mustard and other crucifers, knot-grass (*Polygonum*), and many of the smaller composites. Their specific name is derived from their fondness for the seed of the hemp (*Cannabis indica*). No doubt in New Zealand they feed on small berries and other succulent fruits in addition to seeds of weeds.

The male and female birds show considerable diversity of plumage in the breeding season. The male is about 5¾ in. in length. The top of the head and breast vary in colour from reddish-brown to a fine blood-red, turning to brown in the autumn and winter; the back and upper wing-coverts are brown, while the primaries and secondaries are nearly black thinly edged with white, this white marking being somewhat conspicuous in flight. The tail is also nearly black above; the belly is dull white. It is usually a very conspicuous bird in the height of summer. The female is somewhat smaller, and is more or less brown in colour.

Linnets build a nest of twigs, fibres, moss, and grass, usually lined with wool, hair, or down. It is commonly placed in a low bush, frequently of gorse or broom, or in a hedgerow, but seldom more than 6 ft. from the ground. From four to six eggs are laid. These are about ¾ in. long by ½ in. broad, with numerous spots, streaks, and blotches of reddish-brown or purple on a very pale-green or blue ground.

As soon as the breeding season is over the birds congregate into flocks, which move about the country in a somewhat erratic manner, apparently without any of the direction or unity of purpose which seems to characterize a flight of starlings.

Yarrell, the well-known British ornithologist, says of the song of the linnet: "Towards the close of a fine winter's afternoon the straggling parties that have been foraging all day long congregate

FIG. 18.—THE LINNET (*Linota cannabina*). [*After Bonhote.*

on the top of some tall tree in the sunshine, and at first join in a gentle sort of chirping, presently bursting into a full chorus of song, and then again resuming their single strains continue this performance till the sun is set." We have no records of their song in New Zealand, but Mr. Johannes Andersen tells me that thirty or forty years ago the boys in Christchurch used to catch linnets and sell them to the dealers as songsters.

23. The Goldfinch (*Carduelis elegans*).

The goldfinch is the most beautifully coloured bird now in New Zealand. Especially is this so in the spring-time of the year, when the courting-plumage is at its gayest and brightest. As in all species which build and sit in an exposed nest, the female is less brightly coloured than the male, especially on the head and back, so that when sitting close it is not easily observed. The male is about 5 in. long. The forehead is crimson, the colour extending over the eyes; the back and crown of the head are black, and the sides white; the back of the neck is black, the nape a pale buff-brown, the chin crimson, and the throat white; the back is brown, and the breast a pale fulvous brown, tending to whitish. The greater wing-coverts are partly bright yellow and partly black, while the lesser wing-coverts are black. The tail is black, tipped with white and yellow.

Goldfinches are fond of flying in little flocks, sometimes of five or six up to twenty or thirty in number, and the writer has frequently noted in past years the occurrence of flocks of these birds in his garden from May to September. After the latter month they tend to pair off, and do not usually gather together again till the breeding season is quite past. When these flocks are moving about on short green grass they look like animated jewels. One of the most beautiful sights of the kind which the writer ever saw in his garden was one September morning, when a flock of goldfinches and a number of wax-eyes were moving about on the lawn, the edges of which were fringed with beds of yellow, white, and blue crocuses in full bloom. The black, red, and gold of the goldfinches, the bright greenish-yellow hues of the wax-eyes, and the brilliant pure colours of the crocuses, which were all fully open to the sun, made a most exquisite and enchanting picture.

The nest is a beautifully built, cup-shaped structure, and is usually placed in a small tree or bush. Some years ago one of my boys showed me a curious nest built in a tree in our Dunedin garden; it really consisted of three nests built one on top of another, and the uppermost and latest one contained five eggs. The nest is commonly formed of grass, moss, lichens, fine twigs and roots, and lined with finer materials of the same kind, along with thistle-down, wool, hair, and feathers. The birds do not take long about building: Morris says the nest is usually completed in about three days.

[*After Bonhote.*

FIG. 19.—THE GOLDFINCH (*Carduelis elegans*).

The eggs are four or five in number; their colour is bluish-white, spotted with greyish-purple or brown, mostly towards the larger end. They are about 0·66 in. long by 0·5 in. broad.

Goldfinches feed chiefly on small seeds, especially of plants of the Composite order, such as thistles, dandelions, groundsel, and ragwort. On the Continent of Europe these birds are known as thistle-finches, and the generic name *Carduelis* is derived from the Latin *carduus*, a thistle. In the garden they may be seen eating seeds of spent godetias, picking the ripe heads of the cornflowers, or busy among the chickweed. Very occasionally they pick up a little

grain, but they eat quantities of seeds of grass and meadow-plantain. Very rarely indeed do they touch fruit, though they have been seen picking haws from the hedgerows; and on one occasion a strawberry-grower complained bitterly to the papers that they committed great ravages on his growing fruit by picking out the seeds and thus completely destroying the berries. Next to the hedge-sparrows they have the best reputation of all the small introduced birds.

The goldfinch has a sweet and varied song, and while singing it may often be observed to turn itself quickly about from side to side. It is an easily domesticated bird, and is very frequently seen in cages "It is the easiest of all songsters to capture, owing to the simplicity with which it yields to the summons of a decoy-bird." It crosses readily with the canary, which is an allied species, and the mules are often very fine songsters.

Young goldfinches are not infrequently killed and eaten by the long-tailed cuckoo and the native kingfisher.

These birds were first introduced into New Zealand by the Nelson Acclimatization Society in 1862. In later years Otago, Auckland, Canterbury, and Wellington imported numbers of them. They appear to have at once established themselves at all the centres and to have quickly spread. They are now very abundant in nearly all parts of New Zealand.

24. The Siskin (*Carduelis spinus*).

This bird was introduced into New Zealand by the Wellington Acclimatization Society in 1876, and by the Canterbury Society in 1879, but in neither district did it become established. But in all the chief centres bird-dealers continually import siskins along with canaries. The latter bird is too tame to succeed in the wild state; it may escape from a cage, but almost invariably falls an easy prey to a cat. The siskin, on the other hand, is much more likely to survive if it gets free. At the present time this species is only known to be wild in the country to the south and west of New Plymouth, and the probable explanation of its occurrence is that the birds originally got away from confinement.

The siskin, which is called by bird-catchers the aberdevine, is a very favourite cage-bird, and mates readily with the canary. It is a good songster. Yarrell says that the male bird in spring has a remarkable song, which resembles the running-down of a piece of clockwork.

The following description is taken from Yarrell's "British Birds":—

"*Male:* Top of the head black, with a yellow band running backward from above each eye; cheeks yellowish-green; back

[*After Sharpe.*

FIG. 20.—THE SISKIN (*Carduelis spinus*).

greenish-olive streaked with black; wing-coverts brownish-black, tipped with yellow; rump yellow; tail-feathers dusky black, the

outer ones yellow at the base; throat and breast yellowish-green, passing into greyish-white on the side and belly, streaked longitudinally with dusky black; irides dusky brown; legs and toes brown. Length 4⅝ in.

"The *female* is smaller, and wants the black crown; the head, back, and wing-coverts are greyish-brown; the lower parts greyish-white, tinged with greenish-yellow on the throat and breast, and all streaked with black."

The nest, which is like that of a goldfinch, though not so neat, is usually built on a fairly high tree. It generally contains four or five eggs, which have a bluer tinge than those of a goldfinch, but are spotted like them with purple or brown. They are usually from 0·6 in. to 0·7 in. long by 0·5 in. broad.

The siskin feeds on the seeds of alder, birch, and larch in Britain, but there is no record as yet of its food in New Zealand.

25. The Greenfinch (*Ligurinus chloris*).

The greenfinch, or green linnet, as it is frequently called, was first introduced into New Zealand by the Nelson Acclimatization Society, the pioneer of most of this work, in 1862. In the following year, according to Mr. James Drummond, "a pair were purchased at auction in Christchurch for five guineas, and were set free. They soon mated, but the only occupant of the nest at first was one little greenfinch. Before the warm summer days had passed, however, a second family of five was reared, and in the following winter a flock of eight was seen daily. In the next year, late in the autumn, more than twenty were flushed from a little patch of chickweed, and it was not long before the birds had spread so widely that their note became a well-known sound in Canterbury." In another account Mr. Drummond gives the date of the introduction into Canterbury as 1866. The Auckland and Otago Societies both followed with further and larger importations, and the birds established themselves at once. They are now particularly common in grain-growing districts, and are frequently recognized, especially in spring-time, by their somewhat harsh notes, which are sometimes mistaken for those of the long-tailed cuckoo, although the scream of the latter is very much more harsh and loud. As the season advances the notes of the greenfinch become more mellow, but at the best the bird is not much of a songster.

[*After Bonhote.*

FIG. 21.—THE GREENFINCH (*Ligurinus chloris*).

This bird is about the same size as the chaffinch, being usually 6 in. long, but it is very readily recognized by its colour, which is mostly yellowish-green over the head, throat, breast, and back, becoming lighter on the under-surface. The wing-coverts are greenish-grey, and the short forked tail is brownish-grey tinged with green, the upper tail-coverts being yellow. The female is like the male, only slightly smaller, and duller in hue.

Nesting begins in September, and apparently two broods are reared each season. The nest is formed of small roots, twigs, moss, and straw well compacted, with finer materials such as thistle-down, feathers, wool, and hair. It is a rather large structure, not very carefully built, with the twigs and moss on the outside, and the horse-hair or wool inside. It is commonly placed in a low shrub or hedge, or between the lower branches of a tree. The eggs are four to six in number, and measure 0·8 in. long, by 0·55 in. broad. They are of a dull-white or bluish-white colour, spotted with purple or brown and more or less streaked with black.

The food is largely graminivorous, hence the bitter wrath of the farmer against this bird. It particularly attacks wheat and barley, but all cereal crops are punished by it. It also feeds largely on seeds, thereby helping the agriculturist, and it is fond of green weeds, such as wild turnip, charlock, dandelion, groundsel, and chickweed. In the spring it often feeds on the young buds of trees. Larvae of insects are principally collected in spring, but the food of the nestlings is apparently not confined to insects, as is the case with sparrows and chaffinches. But the greenfinch is not only very destructive to grain crops; in certain fruit-growing districts it has become a serious pest. In Central Otago it attacks the apricots while the fruit is forming, the cherries while in flower, and later in the season the maturing peaches and plums. In winter it picks the seeds out of the cones of *Pinus pinaster*, and probably from those of other species of pine-trees.

In Europe these birds are very gregarious, and collect in large flocks in autumn, but they do not seem to move far away from farmsteadings and similar localities where grain is to be found.

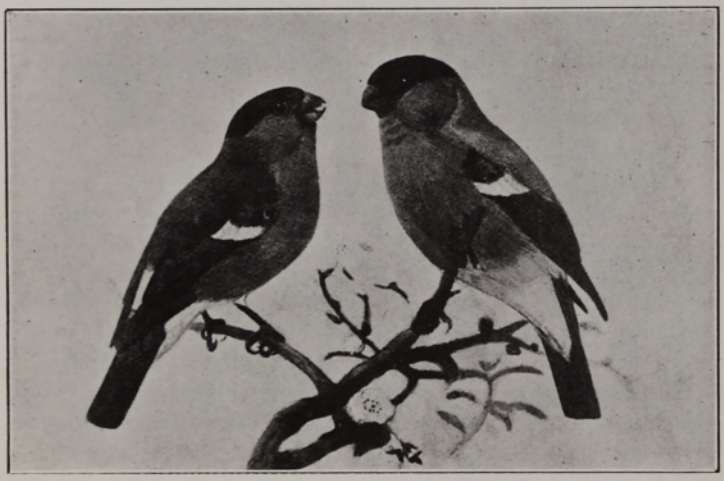
In dairying districts throughout New Zealand these birds are not very common, and wherever grain-growing has been given up and dairy-farming and stock-raising have taken its place they tend to become rarer.

26. The Bullfinch (*Pyrrhula europoea*).

The bullfinch is so strongly marked and so characteristic a bird that it cannot be mistaken for any other introduced or native species.

Introduced into Nelson in the early days of settlement, and into Canterbury in 1875, it failed to establish itself. It is probable, however, that it has often been imported by bird-dealers, for it is occasionally met with in Hawke's Bay, in North Taranaki, and more recently in the Catlin's district of Otago.

The male bird has a hard, short, black bill, broad and thick at the base; the top of the head is deep black with a steel-blue gloss.



[*After Bonhote.*

Fig. 22.—The Bullfinch (*Pyrrhula europoea*).

The nape of the neck and back are dark smoky-grey; the wing-coverts glossy blue-black, tipped with light ashy-grey, forming a conspicuous bar across the wing; tail-coverts and tail glossy blue-black; sides of the neck, breast, and belly brick-red; vent and lower tail-covert greyish-white; legs and toes purplish-brown. Altogether a brilliantly coloured bird. The length is over 6 in., but it looks larger on account of its thick-set build.

The female has the grey of the back mixed with brown; the lower surface is a warm mouse-colour; the head, wings, and tail not so deep or glossy as in the male.

The bullfinch is a shy and retiring bird. It has a plaintive call-note, but a very feeble song. Its food is mainly of a vegetable character, and during the spring months consists largely of the buds of trees and shrubs, hence in countries where it is a common bird it is frequently most destructive to orchards and gardens. Commencing with gooseberries, it proceeds to disbud cherries, plums, pears, and apples. But it has not been known to touch peach or nectarine trees. In the autumn it feeds largely on berries of wild plants, and is particularly fond of rose-hips, a characteristic which should commend it to persons whose land is troubled with briers. The seeds eaten by finches are not passed untouched through the intestines of the birds; they are always destroyed. Therefore such birds do not spread succulent-fruited plants as thrushes and blackbirds do. Throughout the great part of the year the bullfinch feeds on the leaves and seeds of many plants, such as docks, thistles, ragwort, groundsel, plantain, and chickweed.

According to Yarrell, "the nest is a beautiful and very peculiar structure, formed of small twigs deftly interlaid and intercrossed so as to become a very solid platform, in the middle of which is a recess curiously wrought with fibrous roots, some of them of considerable length but coiled and entwined together, those which form the lining being, of course, the finest, and the whole is usually placed on a leafy branch from 4 ft. to 6 ft. above the ground."

The eggs are from four to six in number, of a greenish-blue colour, which, though variable, is never very deep in shade, speckled, spotted, and occasionally streaked with purplish-grey and dark brownish-purple markings, generally distributed towards the larger end and frequently in a zone-like form. They measure from 0·67 in. to 0·79 in. long by 0·52 in. to 0·57 in. broad.

27. Cirl-bunting (*Emberiza cirlus*).

The cirl-bunting was introduced into New Zealand by the Otago Acclimatization Society in 1871, and later by the Wellington Society in 1880–81. In both instances though only a few birds were imported and liberated—seven in the first, and four in the second case—they appear to have at once become established, and to have increased and spread, though they never became very abundant. Their occurrence has been very erratic. At one time they increased to a very considerable extent in Otago. Then for some unexplained

reason they seemed to become quite rare for a time; now they are common again. Mr. James Drummond reported the same phenomenon as occurring near Christchurch.

This bird is closely related to the yellowhammer, and the females and young of the two species are not readily distinguished. Many dealers and bird-catchers do not know the difference between them. In a large cage of so-called yellowhammers caught in the vicinity of Dunedin in October, 1915, a considerable number were cirl-buntings.

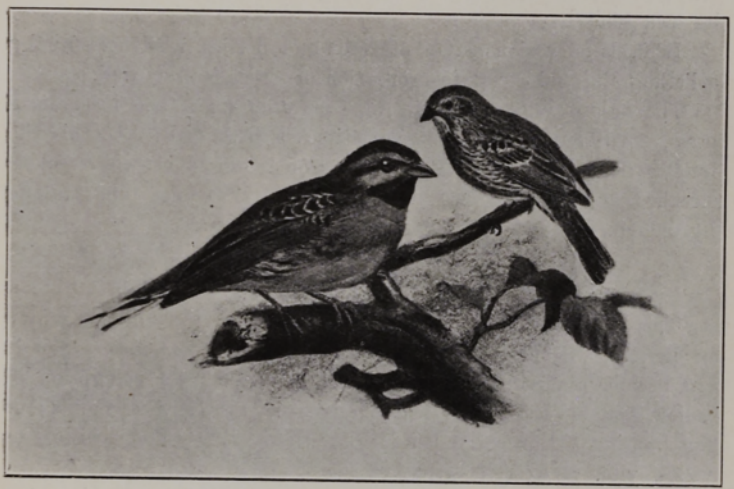


FIG. 23.—THE CIRL-BUNTING (*Emberiza cirlus*). [*After Bonhote.*

The full-plumaged male is easily distinguished from the yellowhammer. It is a slightly smaller bird, and there is a patch or streak of bright yellow on the eye, which comes round and forms a sort of collar below a black patch on the throat, through which a dark streak of a greenish colour passes from the lower bill. The head is yellowish-grey, with the centres of the feathers black. The upper part of the breast is olive or greyish-green, passing below into yellow; the sides are strongly tinged with chestnut. The back is ruddy brown. This and the full black markings about the head are the most distinctive features of this bird. The song, which is hardly worthy of the name, consists of one monotonous

note, which has a different intonation from that of the yellow-hammer, and lacks the final ascending note of the latter.

The cirl-bunting is a bird of the open country, where it gathers in flocks, which, until the beginning of the breeding season in October or November, are composed of birds in full breeding-plumage, while in autumn smaller flocks both of old and young birds are met with. But the cirl-bunting does not "associate in autumn and winter with chaffinches and other allied species in the stubble-fields and farmyards, but keeps to small family parties of its own kind."

It feeds on various kinds of seeds and berries, with occasionally a little grain, and a certain proportion of insect food as well.

The nest is built in a low furze or other bush, and is made of grass, small roots, moss, and sometimes a little hair. In this the four or five eggs are laid. These are of a dull bluish-white colour streaked and spotted with dark brown, and average 0·85 in. long by 0·63 in. broad.

28. The Yellowhammer (*Emberiza citrinella*).

This is one of the commonest birds of the open country in Britain, whence it was introduced into New Zealand, where it has become almost equally common. Its name is a corruption of yellow ammer, the latter being apparently the German equivalent for bunting. In Scotland it is known as the yellow yorling or yellow yite.

In this case, as in most other introductions of small birds, the Nelson Acclimatization Society was the first to import them. This was in 1862, and it was followed by Auckland, Canterbury, and Otago. The Auckland Society in one year (1871) introduced and liberated 312 of them. There was no doubt as to their intention to have these birds, if possible. They quickly spread all over New Zealand, and to-day are common from Foveaux Strait to the North Cape; but they do not appear to occur except where there is grain and grass-seeds.

In full plumage it is a showy bird, with its brilliant yellow coat. The male is fully 7 in. long. The head, neck, and breast are bright yellow, with a few streaks of brown; the back reddish-brown with a tinge of yellow or yellowish-green. The wing-coverts are black, broadly margined with brown and olive, and the primaries are black

with a narrow yellow edge. The tail is slightly forked, and of a brown colour, edged with yellowish-white, which gives the impression of whitish spots on the sides. When the bird is perching it appears to be generally yellow in colour, but when flying the rich brown or chestnut of the lower back and the white of the outer tail-feathers come into view. The flight is strong, quick, and undulating, and when alighting the bird drops suddenly and unexpectedly to the ground. It is the rufous rump and tail-coverts which distinguish the yellowhammer from the cirl-bunting as it flies away from the observer.

Fig. 24.—The Yellowhammer (*Emberiza citrinella*).

This bird generally roosts on the ground, not in the trees like the sparrows. It feeds mostly on grain and other seeds, less frequently on insects and worms. In winter it may be seen pulling the heads out of a corn-stack and stripping them very thoroughly. Great flocks of them gather about the farms, and are never very far away from the straw and grain stacks. They are therefore destroyed wholesale as noxious pests in all the grain-growing districts, a price being put on their heads, and their eggs being purchased by thousands by the County Councils.

Mr. W. W. Smith, writing from Taranaki in 1916, said : " When at Rangiotu Camp in August last I observed these birds there in hundreds, quite tame, subsisting on bread, &c., thrown out from the soldiers' mess." E. Temple Thurston, in " The Open Window," says : " The song is unmistakable. It is as though she were begging from door to door and dared not ask too much. Indeed, in Devonshire the country-folk call her ' Little-bread-and-no-cheese.' Her song is just like that. A little bit of bread and no cheese is her plaint, all on one note until at the last word it drops into a minor third below."

The yellowhammer builds a somewhat bulky nest, usually near the ground, on a bank, in a low bush, or in a bunch of grass, using moss, small twigs, and roots, and sometimes hair, in its construction. The eggs are usually three to five in number, and are purplish-white streaked and spotted with dark reddish or purplish brown. They are almost identical in size with those of the cirl-bunting, averaging 0·85 in. long by 0·63 in. broad.

CHAPTER II.

INTRODUCED FROGS.

Two species of indigenous frogs occur in New Zealand. *Liopelma hochstetteri* occurs chiefly on high ground in the Coromandel Peninsula, and *L. hamiltoni* has been found only on Stephen Island, in Cook Strait, where it occurs near the summit (950 ft.) under stones among bush. In both cases the localities are at some distance from water, except what is obtainable from rain and mist, and both species are therefore peculiarly modified. They appear to have no free tadpole stage. The eggs are laid under logs or stones in slightly damp places. Each is surrounded by a capsule containing watery fluid, and the tadpole stage is passed inside this capsule. About a month or six weeks after the egg is laid the young frog emerges; it is furnished with a long tail, which is gradually absorbed. These interesting frogs belong to a small group the members of which are furnished with a circular tongue; they have teeth in their upper jaw; the fingers are all free, but the toes are webbed, but not dilated at their tips. In addition to these native species, there have been introduced into New Zealand three species of frogs from Australia, two from Great Britain, and at least one species of European toad. Of these, two Australian species, both belonging to the family of Hylidae, or tree-frogs, have become naturalized, and one of them has become very common.

1. Australian Green Frog (*Hyla aurea*).

This species, known in Australia as the green and golden bell-frog, is extremely common in both Australia and Tasmania. It was introduced into Auckland and Canterbury in 1867, and into Southland in 1868. It very quickly spread over the North Island and the northern part of the South Island, but in Otago and Southland it disappeared at first. Probably it was eaten out by wild ducks. Later on numerous

specimens were brought south again, and now these frogs are found commonly in both Islands. Their croak is very frequently to be heard during the summer months.

This frog has a broad, depressed body, which averages about 3 in. in length, by $1\frac{5}{8}$ in. in breadth. The legs are stout and well

[*J. C. Clutton, photo.*

FIG. 25.—THE AUSTRALIAN GREEN FROG (*Hyla aurea*).

developed, so that the animal can jump well. The fingers have small terminal discs; the third finger is the longest. The colour is very variable. In summer it is usually a rich bright green, with rows and streaks of rich yellow and gold; occasionally one entirely bright yellowish-green is met with; the under-side is yellowish-white. Some have dark-purplish spots on the back and sides, while a few are dark

brown or nearly black on the head, back, and sides, and brownish-white below. The frogs are usually green when in ponds or marshes, but the same individual, if captured, will turn brown on the ground or on a floor of a building, and return to its green dress on release in its old haunts. This power of changing its colour is no doubt a protection against cranes and other birds which are met with in the Australian Continent, from which these frogs come, and against snakes, which hunt the frogs when they are lively in the cool of the summer evenings. Fletcher, writing of them in Australia, says they are white-coloured below, but blue and olive above, with blue and brown spots. "Sometimes the same individual is saturated blue and green, with several longitudinal stripes of burnished copper along the back; a few minutes later the stripes glitter like gold, and in other moods the whole surface is mottled blue, green, and brown." The sides, abdomen, and under-parts are covered with small, glandular tubercles, usually a thick yellowish glandular ridge occurs on each side of the body, and there are about four lines of large tubercles on each side of the back.

Though belonging to a family (Hylidae) of tree-frogs the individuals of this particular species do not climb trees. The discs at the tips of the digits are rather small, and are useless for climbing, though they adhere to the fingers. They are typically swamp and river frogs, and are excellent swimmers. The male has a vocal pouch which he swells out when he croaks. On wet days and in the evenings he is very vocal, the "krek, krek, krek," being sometimes deafening; while sometimes an old male, with well-developed vocal sacs, gives out a sonorous "clunk," which can be heard for a long distance. At night, if the ground is wet with rain or dew, the frogs wander over it seeking for slugs, worms, or insects, and are often found thus a long way from water. But in the daytime they keep on the margins of pools, or in the water, taking advantage of any opportunity to capture flies or mosquitoes.

The eggs are deposited on weeds, grass, &c., under the surface of water. According to Professor H. B. Kirk, "the frogs emerge from their winter hibernation about the middle of September, or earlier if the weather is warm. On coming out the females have the abdomen much distended with eggs. Neither males nor females are noticeably wasted, although much of the reserve fat has been used up." Mating does not begin till the middle of October as a general rule, although

it is sometimes as early as the beginning of the month. Spawning is usually very general by the end of October.*

The animal hatched out from the egg is not a frog, but a tadpole, which is more like a fish than a batrachian. At first, respiration is through the skin, but in a very short time rudiments of external gills appear. According to Professor Kirk, who has carefully studied the subject, the further course of development is as follows: "The external gills last only a few days. Even before they are fully developed cavities—taking the form of clefts—grow out from the fore part of the gut towards the outside of the body-wall. Four of these clefts reach the exterior. On the walls are distributed fine capillary vessels constituting gills. The blood-supply to these gills short-circuits, as it were, the blood that has been going to the external gills, and these shrivel and disappear. The gill-clefts are not seen on the exterior, because they become covered by a thin fold of the body-wall closing in a chamber that has a single opening, placed on the left side and somewhat below. The course of water is now in at the mouth, through the gill-clefts into the chamber referred to, and out at the opening or pore. The rudiments of lungs appear while the external gills are forming, and to these rudiments a branch is sent from the fourth vessel, designed to take blood to the internal gills. The internal gills are in their turn short-circuited and disappear, and the lungs come to do the work of oxygenating the blood. The gill-clefts become completely closed." It is thus seen that an adult frog has passed through a fish stage in the course of its development. While this process, which takes several days to accomplish, is going on, the rudiments of hind limbs begin to appear, the tail being at this time rather longer than the body of the animal. Soon after the fore limbs appear, and as the legs develop, the tail becomes shorter by absorption, until the animal is ready to leave the water, come out on the land, breathe by its lungs, and seek for small insects

* In the account of Horn's Scientific Expedition to Central Australia the results of a large series of experiments on the hatching of the eggs of this frog, made by Mr. Alexander Sutherland, are recorded. At a temperature of 30·8° C. the eggs hatched in thirty-four hours, at 26·6° in thirty-nine hours, and at 21·5° in seventy-three hours. The average temperature of ponds and ditches in New Zealand in October is much lower than 21° C., and therefore it is fairly certain that hatching takes several days here

and worms for food. Further observations are wanted as to the time required for all these changes. Tadpoles which are unable to leave the water in which they have been born—as, for instance, those confined in tanks with smooth sides—may grow to as much as 6 in. in length without developing into frogs. Probably such undeveloped specimens cannot survive the first winter.

About the month of April the green frogs begin to enter on their period of hibernation, and by the middle of May it is a rare thing to find one in or near water. They creep under stones or into holes in the ground, often a very considerable way down if the ground is well drained, and it may be a mile from the nearest permanent water; and here they lie secure from the frost and cold till September, when they begin to get active once more. These frogs can live for a long time without food or water, so long as they are not subjected to evaporation. A case is on record* of one which lived inside a ball of hardened and dried clay for fifteen months. When the ball was broken up the frog energed quite cool and moist, and ready for food, for it immediately caught and ate a house-fly which was placed near it. In periods of prolonged drought in Australia the frogs have been found deep down in the dried mud of the pools which they frequented, living in a cell of puddled clay, which sometimes contains as much as half a pint of clear, cold water.

2. Australian Brown Frog, or Whistling Frog (*Hyla ewingii*).

This little frog is found only in the neighbourhood of Greymouth, Westland. It was introduced in a curious manner. A Mr. W. Perkins brought some over from Tasmania in a bottle in 1875 and liberated them in a drain in Alexandra Street, Greymouth. From there they spread up the Grey River some twenty-four miles to Ahaura on the south bank, but do not seem to have got to the north side. They also spread south for a few miles. Three years later Mr. F. E. Clarke found a tadpole in a drain at Hokitika, and was quite at a loss to explain its occurrence, as he had not heard of the frogs at Greymouth. Some one had probably carried either tadpoles or frogs to Hokitika, which is twenty-four miles distant, for the species is scarcely or not at all

* See "The Naturalization of Animals and Plants in New Zealand," by Geo. M. Thomson, p. 180

found between the two centres. Of late years these frogs have become very rare or are extinct, having apparently been displaced by the larger *Hyla aurea*, which has spread to the West Coast either from Canterbury or Nelson.

This is a small species, usually less then 2 in. in length. The fingers have a slight rudiment of a web between them, and the toes are half or two-thirds webbed. (In *Hyla aurea* the fingers are quite free, and the toes are always more than two-thirds webbed.)

The colour is brownish or greyish above, often speckled with black, with a dark streak near the top of the head, and below

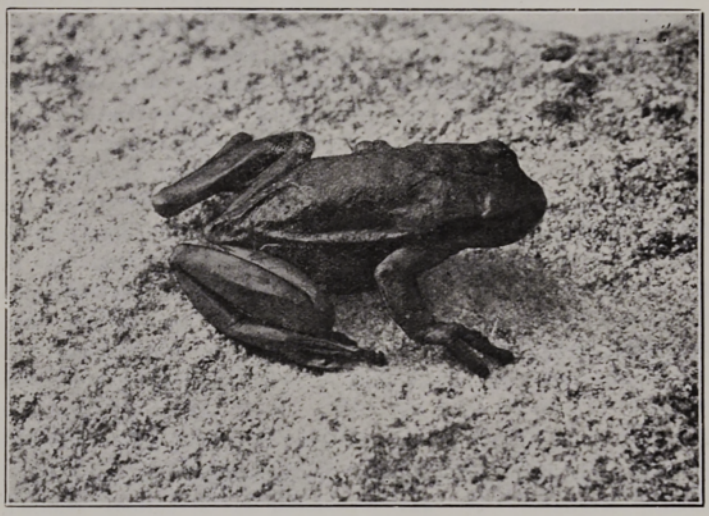


Fig. 26.—The Australian Brown Frog (*Hyla ewingii*).

this a whitish streak from the eye to the shoulder; while a dark blotch stretches from between the eyes down to the middle of the back. The lower surface is white.

This frog occurs in the southern portion of Australia from Gippsland to Western Australia, and also in Tasmania. The frog found in Westland belongs to the variety *calliscelis*, in which there is a large purplish-black spot on the yellowish sides of the thighs, and a similarly coloured spot in the groin.

Nothing has hitherto been recorded as to its life-history. There is an interesting field of observation open here for some local naturalist.

CHAPTER III.

INTRODUCED FISHES.

Attempts have been made to naturalize two European marine fishes in New Zealand—viz., the herring (*Clupea harengus*) and the turbot (*Rhombus maximus*). Two experiments to import herring-ova have failed completely. It is not yet known whether the attempt to introduce the turbot in 1913 is a success or not.

Of fresh-water fishes no fewer than thirty-two species have been experimented with; we cannot say they have been introduced, but either the fish or the eggs have been shipped to New Zealand, and either died before or shortly after their arrival in the colony. Some twelve or thirteen species have become naturalized, but one or two of these are still doubtfully claimed.

I am very largely indebted to Mr. L. F. Ayson, Chief Inspector of Fisheries in New Zealand, for much of the following information on the habits of our introduced fishes. He has an unrivalled knowledge of the subject, having been closely connected with fish-culture in the Dominion for over thirty-seven years, and his information is accurate. He has also been very generous in communicating it to those who sought his aid.

The Salmonidae.

The seven species of the salmon family now naturalized in New Zealand belong to three very closely allied groups, which are designated as distinct genera by some systematists. They are *Salmo*, *Salvelinus*, and *Oncorhynchus*. The differences which separate them are very slight. Species of *Salmo* — to which belong the Atlantic salmon (*S. salar*), brown trout (*S. fario*), rainbow trout (*S. irideus*), and the Mackinaw or great American lake trout (*S. namaycush*)—have fewer than fourteen rays in the anal fin; they also have teeth on the body of the vomer, as well as on the head, except in the last-named species, which has no teeth on the vomer — the vomer being the hammer-shaped bone the head of which marks the anterior end of the palate.

Species of *Salvelinus*, or char, to which the American brook-trout *S. fontinalis* belongs, have also fewer than fourteen rays in the anal fin, and the vomer bears teeth only on its head.

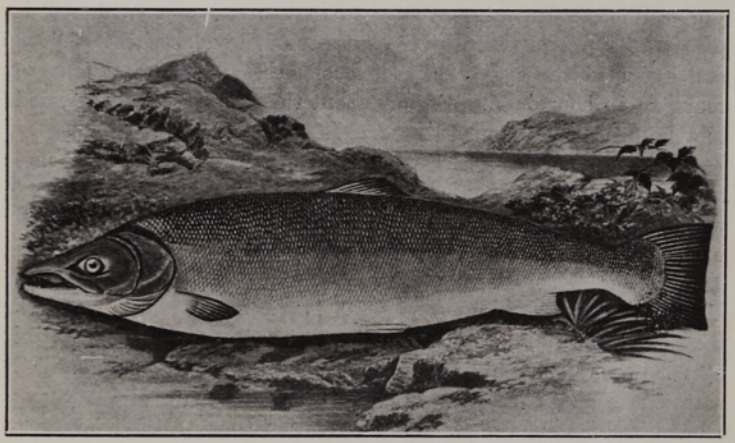
Species of *Oncorhynchus*, to which the quinnat salmon (*O. tschawytscha*) and the sockeye salmon (*O. nerka*) belong, have more than fourteen rays in the anal fin.

1. Atlantic Salmon (*Salmo salar*).

Since 1864, when Mr. A. M. Johnson, of Opawa, Christchurch, made an unsuccessful attempt to bring out live young salmon to New Zealand in a sailing-vessel, down to 1911, continuous efforts were made by acclimatization societies, and latterly by the Government, to naturalize this splendid fish in our rivers. Nearly five million eggs were introduced at different times, and these were obtained from various rivers — the Tay, Forth, and Tweed in Scotland; the Severn, Wye, Tyne, Ribble, Hodder, Lune, Avon, and Dart in England; the Rhine, and some Canadian rivers. From these over 2,500,000 fry were hatched, and were ultimately liberated in between twenty and thirty streams in this country, mostly in the South Island, and notably in the Clutha and the Aparima. All these early attempts failed. Although one or two fish definitely identified as "salmon" were taken in the half-century during which this work was being attempted, it was not till 1921 that it was found that this very fine species was actually running in the Waiau River in Southland, and was spawning there. Apparently these fish were the product of eggs introduced by Mr. L. F. Ayson and his son, Mr. C. L. Ayson, acting on behalf of the Government, between 1908 and 1911, and hatched in a small stream — the Upokororo River—which flows into Lake Te Anau. These eggs, numbering over 1,750,000, came from Canada, Ireland, the River Tay in Scotland, the Dee in Wales, the Test in Hampshire, and the German Rhine. These hatched out very well; numbers must have gone down to the sea as "parr," and now they are coming back to the river in which they were hatched. It is impossible to say whether these fish are from Canadian, Scotch, Irish, English, or German rivers, or whether they are from all the sources. It may be that only one lot furnished the present supply. The fish run up from November to May and June, and fish weighing 17 lb. and measuring 30 in. have been taken. The Fishery Department is now

getting an annual supply of ova from the Waiau River, from which it is hoped in a few years to stock several streams with this prince of fresh-water fishes. The Wanganui is the first North Island river to be stocked.

The salmon, when it first runs up a river from the sea, is one of the most beautiful of fishes, graceful in form, and with a coat of pure silver, through which its black spots faintly show. It is distinguishable from other large salmonoids by certain features. The fin characters are fairly uniform, the dorsal has 14 rays, the adipose is rayless, the pectoral has 14, the ventral 9, and the anal 11. The



[*After Houghton.*

FIG. 27.—THE ATLANTIC SALMON (*Salmo salar*).

relatively large scales of the tail number 11 in a transverse series from the adipose fin to the lateral line. When the fish is opened the pyloric appendages (fine closed tubes) of the stomach are found to number generally from sixty to seventy. These fresh-run fish are from 2 ft. to 5 ft. in length, and weigh from 10 lb. to 30 lb. or more. A maximum weight for salmon taken in British rivers is 83 lb.

After the fish have been in fresh water for a few weeks they lose their pristine beauty; the silver turns to a more or less coppery brown, with a darker hue on the throat and under-parts. The old

males also develop a snout, while the lower jaw lengthens and bears a knob, which forms a pronounced hook. When spawning begins, which in New Zealand is from 1st June to about 15th August, the female fish swims over a gravelly shallow where the current is brisk, and, having chosen a spot to her liking, she rolls upon her side and flaps her tail rapidly so as to fan up the gravel, thereby excavating a hollow. This process may take from one to several days, and when ready she deposits such of her eggs as are ripe for shedding. Then the male moves up and sheds his milt upon them, and as the fish works up-stream the action of the fins and tail buries the eggs as fast as they are impregnated. This process is repeated daily until all the eggs are deposited. When first extruded the eggs adhere to each other, but separate in the course of an hour or so. Each is about the size of a small pea, and of a bright orange colour.

The development of the salmon is very interesting. The eggs hatch out in about fifty days, the length of time varying, however, with the temperature, and the minute fry have the yolk-sac attached behind the gill-opening. Up to about two months the little fish draws its nourishment from this sac, and is then about $1\frac{1}{4}$ in. long. Up to fifteen months the young fish is called a "parr." It is a beautiful little fish, dark olive on the back, with nine or ten vertical bars showing on the sides on a paler ground, which is thickly marked with black and red spots. This is a characteristic of all young salmon and its immediate allies. By this time the fish is about 5 in. long, and weighs 2 oz. to 3 oz. Then it gradually changes colour, the back becomes bluish, the sides like silver, and at this stage (smolt stage) it goes down to the sea. Some stay another year before they make the journey to the salt-water. When they do return, which is either in a year or two, they are termed "grilse," and weigh from 2 lb. to 5 lb. They continue to run during the season till 10 lb. or 12 lb. fish are taken. These fish apparently never feed in the rivers, or at least do so to a very slight extent. After a time they return to the sea as "pelts" for more food. When they ultimately come back to the rivers it is to spawn.* In

* While at sea the salmon is purely carnivorous and very voracious, feeding entirely on smaller fish and on crustaceans, such as shrimps and amphipods of various species. In the North and the Baltic Seas sand-fleas (amphipods) rank with sand-eels and herring in importance as food for salmon, and in the Baltic a hook-and-line fishery is carried on with herring as bait.

Britain marked fish going to sea in January to March return in June and July, and are found to have increased from 100 to 250 per cent. in weight—*i.e.*, a 4 lb. grilse may come back in four or five months weighing from 8 lb. to 14 lb. As a rule, salmon return to the river they are bred in.

Salmon-fishing is considered by anglers to be the finest kind of piscatorial sport, for though the fish do not feed to any extent in rivers, yet they rise to flies. Sir Herbert Maxwell explains this by stating that "the predaceous instinct, irritation, and perhaps occasional spasms of appetite, prompt them to seize and even to swallow life-like moving objects." Then he goes on to point out that the so-called "'salmon-flies' are pure inventions, and do not resemble any known insect. Yet the fish rise to them, however wild and bizarre they may be. When hooked the fish makes a most violent effort to free itself, and the more violent its struggles to escape, the better sport [*sic*] is it considered."

2. Common Trout; Brown Trout (*Salmo fario*).

This fine fish, now so common throughout New Zealand, was first introduced from Tasmania by the Canterbury Acclimatization Society in 1867, and by the Otago Society in 1868. These Tasmanian trout appear to have hatched from ova obtained from three localities in England. Some came from Wycombe, in Buckinghamshire, from a little stream which flows into the Thames; a second lot from the River Wey, which rises near Selborne, in Hampshire, and flows into the Thames; and a third from the River Itchen, in Hampshire. From these early shipments all the millions of brown trout now in New Zealand are descended.

In Britain the brown trout is not usually a large fish, a 5 lb. specimen being considered a very good one. But in New Zealand waters, and especially in the lakes of both Islands, they grow to a great size, occasionally up to as much as 25 lb. in weight. The specimen shown in Fig. 28 is a male of 25 lb. caught in Lake Hawea, Otago. In the first days of stocking of streams and rivers the rate of increase of the young fish was very rapid on account of the immense amount of available food — smelts, minnows, crayfish, shrimps, insects, and insect-larvae of many kinds, &c. This increase varied from ¾ lb. to 3½ lb. per annum in various streams and lakes. But the food-supply was soon eaten out, and the rate of increase became much lower. The supply of fish in most of the streams in now kept

up by the various acclimatization societies, which hatch out trout-eggs by the hundred thousand and liberate the fry in the waters to be stocked. Natural stocking does not seem to be very effective, perhaps owing chiefly to the depredations of eels and shags.

The brown trout is a gracefully formed fish, with the head rounder and the body thicker than in the salmon. In its best condition the colour is brownish or olive as a ground-tint, passing into gold on the flanks and pure-white on the belly; the back varies from nearly black to olive-green or pale brown, or even yellowish, according to the colour of the ground over which the fish swims; the sides are more or less thickly spotted with black, usually mixed with smaller bright scarlet spots, the latter particularly on both sides of the lateral line.

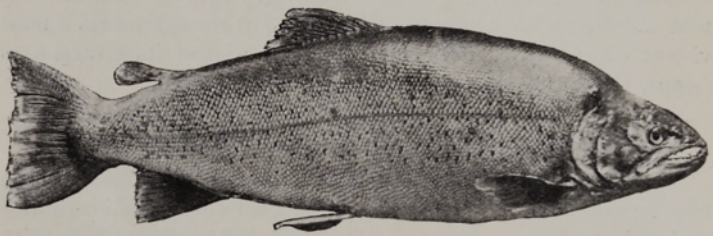


Fig. 28.—The Brown Trout (*Salmo fario*).

The head of the male fish becomes larger than that of the female, and the lower jaw becomes hooked. The male fish are usually rather golden in hue and the females silvery. At spawning-time the metallic hues and lustre fade away, the sides become dark and blackish, and the skin gets rather slimy.

The fin characters are as follows: Dorsal, with 12 rays, which decrease in length backwards; pectoral, round, with 13 rays; ventral, close to each other, with 9; and anal, with 10. The wide concave tail has 22 rays in its rounded upper and lower portions. The scales of the tail number from 13 to 15 from the adipose fin to the lateral line.

Trout feed ravenously till spawning-time, but afterwards remain lank and emaciated till well into the spring months. It is for this reason that the fishing season in New Zealand does not open till October, by which time they have regained their brilliancy. The

spawning season in this country lasts from about 10th May to 15th July, and the number of eggs produced varies according to the size of the fish, a ½ lb. fish producing about 400, and a 7 lb. one as many as 6,000. On an average, brown trout from 3 lb. to 7 lb. or 8 lb. in weight give 800 eggs to the pound; fish over 8 lb. and up to, say, 15 lb. give about 550 eggs to the pound. Thus, while a 7 lb. fish might give as many as 6,000 eggs, a 15 lb. fish would probably give fewer than 8,000 eggs.

The length of time taken for the hatching of the eggs and the subsequent growth to the alevin stage depends mainly on the temperature. With an average water-temperature of 50° F. the eggs hatch in from forty to forty-five days, and another thirty-two days is required to bring them to the stage when they commence to feed (alevin stage). The growth from this stage onwards depends, as already stated, on the abundance of the food-supply. But at the outset they grow to about 1½ in. long in the first six weeks, and at three months to about 3 in.

Lochleven Trout.

This is only a local variety of the common brown trout of Britain, which has been developed, probably by long isolation, in the small

Fig. 29.—The Lochleven Trout (*Salmo fario levenensis*).

lake termed Lochleven, in Fifeshire, Scotland. That it is only a variety, and not a distinct species, is proved by the fact that it crosses quite readily with the common trout, and the hybrids are perfectly fertile.

The colour of the back is usually of a deep olive-green, the sides are lighter, and the dark spots are not mixed with red ones. The pectoral fins are pointed and not round, and the rays of the

tail are much longer and more pointed than in the common variety. It is a more delicate fish than the latter.

Ova were successfully imported in 1883—earlier attempts having failed—and were divided between the Otago and Wellington Acclimatization Societies. Later on others came to Wellington and Canterbury. Fry have been distributed right through the South Island, and as far as Mount Egmont in the North Island.

3. Rainbow Trout (*Salmo irideus*).

This beautiful species was first introduced into Auckland in 1883, ova being obtained from San Francisco.* The majority of the fish now in New Zealand were derived from shipments received by the Auckland Acclimatization Society. In later years Mr. A. M. Johnson, who kept a fish-farm at Opawa, Christchurch, imported some more ova, and the fry were probably distributed mostly in Canterbury. Rainbow trout are now abundant in rivers and lakes throughout both Islands, but the largest fish, running up to 24 lb. weight, have been taken in Lake Taupo.

It is affirmed by some anglers that where rainbow and brown trout are found in the same river the former go up the stream and occupy the headwaters, while the brown trout are chiefly found at the river-mouths. Others state that in all the large lakes rainbow trout remain in the lake throughout most of the year, and only move up the streams on the approach of the spawning season.

The rainbow trout is an extremely variable species in its native haunts in North America, the commonest forms occurring up to 6 lb. in weight, while such mountain forms as the Nissuee or No-shee trout run up to 12 lb. But in New Zealand waters, and especially in large lakes, like Hawea and Taupo, fish double these sizes occur commonly, and this leads to the supposition that two allied species have been introduced.

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* Mr. Ayson informs me the first lot of ova was obtained by Mr. T. Russell, of San Francisco. The curator of the hatchery from which they were obtained stated that the ova sent were those of steelhead, which he said were sea-run rainbow trout. The steelhead (*Salmo gairdneri*) is, however, a distinct but closely allied species, which Jordan and Evermann consider passes into *S. irideus*. It runs up to 20 lb. or more. The New Zealand Marine Department has obtained large specimens of rainbow trout, and has sent them to America for identification, but no reply has yet (July, 1925) been received.

The typical rainbow trout has a comparatively short and deep compressed body, the males being considerably longer than the females. The eye is relatively large. The colour is bluish or bluish-green above, and the sides are silvery. All the body but the belly is profusely and irregularly spotted, and there is a prominent red lateral band. The scales are relatively large. The specific name (*irideus*, or rainbow-like) is derived from the bright colours of the fish.

Rainbow trout are game fighters, and afford great sport to anglers. They are also most excellent table fish. The spawning season in New Zealand lasts from July to October in the North, and from the beginning of August to November in the South. At Clinton, Otago, the main stripping takes place at the beginning of September. The average weight of the stripped fish is about 4 lb., and each female produces about three thousand eggs.

Fig. 30.—The Rainbow Trout (*Salmo irideus*).

In water at a temperature of 56° F. the ova become eyed in about nineteen days, and hatch out in forty-two days.

When first introduced into streams or lakes the rate of growth is frequently phenomenal. From 1½ lb. to 3 lb. a year has often been recorded, but the maximum growth has occurred in Lake Hawea. Fry were liberated there for the first time in November, 1911, and in less than two years fish weighing 10 lb. were taken in set-nets along the shallow beaches. In Lake Taupo, where fry were placed in 1903, fish weighing from 10 lb. to 18 lb. were taken in 1906. This remarkable rate of growth was due to the super-abundant food-supply. It has not been maintained in later years. Indeed, the natural supply is being so rapidly exhausted in all the lakes and rivers where trout abound that artificial means of restoring it will have to be adopted.

4. Mackinaw Trout (*Salmo namaycush*).

This species, which is sometimes known in America as the great lake trout, is one of the largest of the Salmonidae. In its native habitats it attains a huge size. While a fish measuring 36 in. in length will weigh about 17 lb., it grows, under favourable conditions, to a length of several feet, and specimens weighing over 100 lb. have been hauled up from the depths of the great lakes of America. "Hauled up" is the correct expression, for these fish appear to live in the deepest water.

It is difficult to know why these fish were introduced into New Zealand, but some years ago the Tourist Department was dominated by the idea of dumping all sorts of animals, from moose downwards, into this favoured land. It was at the request of the Department that Mr. L. F. Ayson introduced a box of eggs of this species from America in 1906. They were hatched out at Christchurch, and the fry were not scattered broadcast, but were liberated only in Lakes Pearson and Grassmere. It was felt that they might prove dangerous to other trout if they were placed in the larger lakes. These two lakelets lie on the east of the West Coast Road, at the foot of Mount Burnett.

This trout has been placed by some naturalists in a distinct genus—*Cristivomer*—on account of the presence of a raised crest behind the vomer and free from its shaft, and this crest is armed with teeth. The general colour is a dark grey, marked everywhere with rounded spots of a paler colour, which are often reddish-tinged. The head is very long, and flattened on its upper surface. The caudal fin is well forked, and the adipose fin is small.

Very little is known about these fish in New Zealand. What information I have is derived from Mr. Edgar Stead, of Ilam, Christchurch, and Mr. D. Hope, Curator of the Christchurch Acclimatization Gardens.

Both the lakes in which Mackinaw trout have been placed have also been stocked with rainbow trout. Lake Grassmere is unfishable without a boat, and no one seems to know how the two species have thriven in it. But Lake Pearson is regularly visited by anglers, who are after rainbow trout. Those fishermen who have caught Mackinaw trout have trolled from a boat, either with spoon or minnow. All the fish taken near the surface of the lake were rainbows. But when a very heavy lead was used so as to spin in

deep water the Mackinaw trout were caught. They averaged between 8 lb. and 9 lb. in weight, but were in very poor condition, and gave no sport. Apparently they have never been taken with a fly. One angler informed Mr. Stead that small shoals of from six to a dozen Mackinaw trout were seen swimming in shallow parts of the lake, "which is quite contrary to their habits in their native waters in America." Mr. Stead thinks this habit and their poor condition are indications that they have cleaned out their food-supply in the deeper portions of the lake. This seems to me the probable explanation, and it would appear that they are now living on smaller fish of their own species or of the rainbow trout. This is what happened in Lake Wakatipu in the early days of brown-trout distribution. The first fish put into the lake grew at a

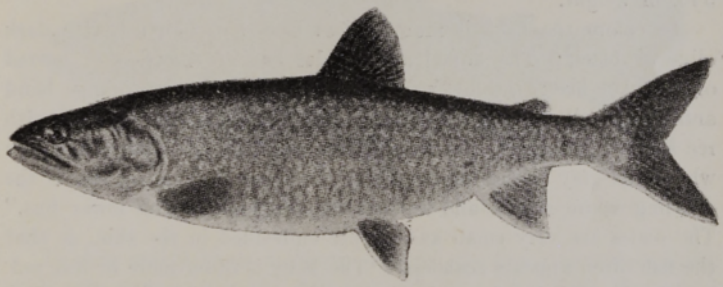


FIG. 31.—THE MACKINAW TROUT (*Salmo namaycush*).

phenomenal rate, and then, almost suddenly, when their numbers had greatly increased, they became very thin, and were reduced to mere slabs.

Mr. Hope thinks the Mackinaw trout have bred in the lake, as those originally placed in its waters in 1906-7 should be much larger than 8 lb. or 9 lb. fish. He states that the rainbow trout in Lake Pearson spawn on the shingle-slips running out from the shore at various points, and that probably the Mackinaw do the same. There is enough seepage through the shingle to supply current and aeration for the hatching of the eggs. It may be, therefore, that large fish occur in the deeper portions of the lake. It is evident that there is much interesting information to be learned about this large kind of trout.

(Mr. Hope informs me that in March, 1926, a large Mackinaw trout was taken in the estuary of the Waimakariri. It had evidently come from Lake Pearson, down the Winding Creek into Broken River, a tributary of the Waimakariri. Rainbow trout from the same source have been taken not infrequently in the same river.)

5. American Brook-trout (*Salvelinus fontinalis*).

This fish is the best known of the American chars, a group which forms the genus *Salvelinus*. "Its members are by far the most active and handsome of the trout family, and live in the coldest, clearest, and most secluded waters." This species occurs in abundance in all clear, cold streams from Maine to Saskatchewan, and northward into Labrador. It is rather a small species, seldom exceeding 18 in. in length, and only rarely growing to as much as 5 lb. in weight.

In colour the back is more or less barred or mottled with dark olive or black; The dorsal and caudal fins are mottled or barred of a darker hue; the lower fins are dusky, with a pale-orange band anteriorly, followed by a darker one. The sides are marked with red spots. Holder says of these spots that they are "surrounded by whitish or grey circles, and possibly the most striking feature is the dazzling white streak and colours on the edge of the lower fins." The scales are very small and deeply embedded in the skin, so that the fish often appears scaleless. The belly is often more or less red.

The brook-trout is a very alert fish and quick in its motion. Mr. Wilfred Howell, of Cave, near Timaru, says: "As far as sport is concerned I think the *fontinalis* are a failure: they are too easily caught. They will take almost anything, from a red leaf pulled through the water to a minnow. They will take meat, part of another fish's gill, and any fly with much red hackle on it. When hooked they have only one good run in them, and then you can pull them wherever you want them."

Brook-trout in New Zealand spawn from 1st May to 15th June. A well-conditioned fish from 2 lb. to 5 lb. weight will produce about eight hundred eggs to every pound the fish weighs. These will hatch out in from thirty-six to forty days with a temperature of 50° F. The rate of subsequent growth is not very rapid. Where there is plenty of food the fish will weigh about 2 lb. in its second year.

The first introduction of these fish took place in 1877, when ova were received from America, and were hatched out both in Christchurch and Auckland. Most of the fish now in New Zealand streams came from Canterbury. The ova do not appear to carry well, for in subsequent shipments received from the United States, out of nearly one hundred thousand eggs shipped only some three thousand five hundred fry were hatched.

At the present time brook-trout are by no means common in this country. They are relatively small, and when placed in the same stream as brown or rainbow trout they very soon disappear. They are still found in the headwaters of some streams in Otago and Canterbury, but are scarcely known elsewhere.

FIG. 32.—THE AMERICAN BROOK-TROUT (*Salvelinus fontinalis*).

In their native home in North America the brook-trout frequently seek salt water after the breeding season, and remain there over the winter. They are then known as sea-trout, or salters, and are coloured very differently from the fresh-water fish. They are steel-blue or bottle-green on the back, with cheeks and sides silvery like a salmon, and with a white belly. These sea-run trout have never been observed in New Zealand, probably because the fish is not able in this country to hold its own against other imported species.

6. QUINNAT OR CALIFORNIAN SALMON (*Oncorhynchus tschawytscha*).

This fish is variously known in America as the *quinnat*, *chinook*, or *king-salmon*. It occurs in vast quantity on the coasts of California, British Columbia, and Alaska, and ascends the larger rivers in countless numbers to spawn in their headwaters, often a thousand miles from the sea. It is considered to be by far the most valuable of the American Salmonidae from a commercial point of view.

In 1875 the first lot of quinnat-salmon ova was introduced by the Hawke's Bay Acclimatization Society, and during the next three years nearly a million eggs were received in New Zealand, and were distributed from Auckland to Southland. Apparently all these experiments failed, none of the fry becoming established. In 1900 the Government took up the matter and decided to make a definite effort to naturalize the fish, the policy being to introduce large quantities of ova, hatch them all in one stream, and continue the experiment until the fish were thoroughly established. The Waitaki River was selected, and between 1901 and 1907 nearly two million ova were brought over from California, and were hatched out either in the Hakataramea River, one of the tributaries of the Waitaki, or in Lake Ohau. Salmon began to appear in 1905 and

Fig. 33.—The Quinnat Salmon (*Onchorhynchus tschawytscha*).

1906, and in the following year they commenced to run up the river, and ova were obtained from them. Their numbers continued to increase, and year by year they extended their range north and south, until now they are found in great quantity from the south of the South Island to several of the rivers of the southern end of the North Island. The success of this experiment is entirely due to Mr. L. F. Ayson, Chief Inspector of Fisheries in New Zealand.

While there is no question as to the success as a piece of excellent work in naturalization, there is much doubt expressed as to whether the right kind of fish has been introduced into this country. Many anglers who have caught these salmon in the Waitaki and Rakaia Rivers, and in Lake Wanaka, affirm that the flesh is dry and lacking the colour and fatness of good salmon, and

that it is altogether an inferior fish. Of course, all salmon deteriorate rapidly after leaving the sea, and it may be that most of these fish had been too long in fresh-water.

The fish introduced into New Zealand are all autumn-running salmon of moderate size. If any mistake has been made in bringing the wrong race of quinnat into the country the blame does not lie with Mr. Ayson or the local Department, for all the ova were supplied by the American Fish Commission Department, the members of which would naturally be considered the best authorities on the subject.

An interesting fact about these introduced salmon is that they have naturally spread both north and south in this country. Both Drs. Starr Jordan and W. Barton Evermann, two of the leading authorities on fish in western North America, affirm that the quinnat always returns to the river in which it was hatched. They state that this is found to be the case with all marked fish which have been liberated in the United States. This is certainly not the case in New Zealand. Salmon appeared in the Rangitata, Rakaia, and other rivers to the north, and in the Clutha in the south, which had been hatched and reared in the Hakataramea. This fact has surprised American naturalists, but that it is a fact and not a surmise is undoubted.

The appearance and colour of this species vary with the season of the year. The upper part of the body is dusky, often tinged with olivaceous or bluish, the sides and belly silvery-white; the head is dark-slate colour, usually darker than the body, and little spotted; the back, dorsal fin, and tail are usually profusely covered with round black spots, while the sides of the head and the caudal fin have a peculiar metallic tin-coloured lustre. In spring the fish are quite silvery in appearance, and the flesh has the typical salmon-red hue. But as the spawning season approaches this silvery colour is lost, the fish becomes dull, and the males acquire a blackish hue, more or less tinged or blotched with dull red. The flesh, too, becomes pale. The head is conical in shape, but in late summer and autumn the head of the male fish changes very materially, the jaws—and especially the tip of the lower jaw—become elongated and strongly hooked, and the anterior teeth are much enlarged. In their native habitat most of the fish which reach the upper waters of the streams they ascend perish from exhaustion. We

cannot say definitely yet whether this is or is not the case in New Zealand.

In this country the fish spawn from about 15th April to 31st May. Mr. Ayson states that "a late run comes in to the lower reaches of the Waitaki River about the end of May and spawns during the first ten days of June." Fish weighing from 12 lb. to 16 lb. produce about five hundred eggs to the pound; as the weight increases up to, say, 30 lb., the relative number of eggs diminishes to about three hundred to the pound weight of fish. With a water temperature of about 50° F. the eggs take about fifty days to hatch, and in another forty days the fry begin to feed.

There is no definite information as to the rate of growth of the quinnat salmon in New Zealand rivers. In the Columbia River the average weight of the fish taken is 22 lb.; in the Sacramento River it runs from 16 lb. to 18 lb.; but individual fish from 70 lb. to 100 lb. have been taken.

There is considerable diversity of opinion as to the sporting qualities of this fish. Dr. Holder, author of "Game Fishes of the World," says that "the chinook in its best condition, full of fight and ranging up to 50 lb., affords excellent sport; but, if allowed, the fish will go down into deep water, and will sulk." He further says they will not take a fly, but are caught by trolling. "At Monterey they are caught at sea by a sardine or smelt, and as the fish generally lies thirty or more feet below the surface a detachable sinker is used, which comes off at the strike and permits the angler to fish at ease." In New Zealand the quinnat will take any spinning bait readily, but only occasionally does it rise to a fly. Mr. E. Stead suggests that this may be because their native waters are mostly discoloured, and that in clear water they might take the fly as readily as Atlantic salmon do. He adds, "I have had magnificent sport with them, on many occasions hooking fish that gave me all the fight I wanted. . . . I have found them, as a whole, strong fish as well as lively and persistent fighters."

7. Sockeye Salmon (*Oncorhynchus nerka*).

This North American species is sometimes known as the blue-back salmon, the sawqui salmon (of which name sockeye is a corruption), and the red-fish of the Fraser River. It occurs also in Japan, where it is known as the *Krasnaia ryba*. It is one of the

most graceful of the Salmonidae, and scarcely inferior to the quinnat when fresh, but when cooked the flesh is more watery and less valuable. It is the principal salmon of Alaska.

Only one shipment of ova (500,000) was made to New Zealand. This was in 1901-2. The eggs came from Canada via San Francisco, and were in bad condition on arrival. Still, a large number of fry hatched out, and the majority of these were placed in Lake Ohau, and the rest in tributaries of the Waitaki River.

The fish has become established in Lake Ohau, and a few appear to go to sea, the first sea-run specimen having been taken in May, 1906. But the most of them remain in the lake, and run into the creeks at the head of the lake each spawning season. They are

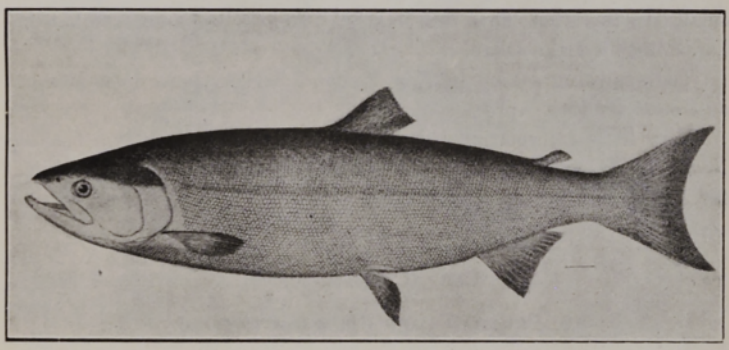


FIG. 34.—THE SOCKEYE SALMON (*Onchorhynchus nerka*).

not numerous, and are dwarfed in size, the average fish being under 2 lb. in weight.

The following is a description of the fish: The body is elliptical and rather slender; the head short and sharply conical; the caudal fin narrow and widely forked, and the anal fin long and low. In spring the colour is clear bright blue above, sides silvery, the lower fins pale and the upper dusky. No spots are visible, but the young fish have obscure black spots on the upper parts. As the breeding season comes on, the colour of the males turns to blood-red on the back, with dark edges to some of the scales; the middle of the sides is darker red, the under-parts dirty-white, with numerous fine dark dustings; the top and sides of the head are green or

olivaceous, the tip of the nose and sides of the jaws red, the underpart of the lower jaw white ; the dorsal fin is pale red, the anal darker, adipose red, the ventrals and pectoral fins smoky with some red at the base. The males become extravagantly hook-jawed in autumn, the snout being prolonged and much raised above the level of the rest of the head, and the lower jaws prolonged to meet it.

The colour of the breeding female is essentially the same as that of the male, but rather darker on the sides.

The flesh is a deep red. In their native habitat a fully mature fish is about 2 ft. long, and weighs up to 8 lb., but in Lake Ohau 2 lb. is about the maximum weight.

Dr. Holder, quoting Professor Starr Jordan, says : " The red salmon will enter only rivers which pass through lakes, and will spawn in small streams that flow into lakes." This is apparently what is happening in Lake Ohau.

The spawning season in New Zealand begins about 15th March, and ends on 15th April.

Very little information is as yet available regarding this fish in New Zealand, and few observations have been recorded of its habits, for Lake Ohau is not much visited.

8. Carp (*Cyprinus carpio*).

9. Prussian Carp (*Carassius vulgaris*).

10. Gold and Silver Fish (*Carassius auratus*).

It is desirable in an account of the fish which have been introduced into New Zealand to treat these three species together, for they were imported at various times together, and there is no clear record as to where and when this happened.

In 1864 Mr. A. M. Johnson, the pioneer in all fish-naturalization experiments, brought out some gold-fish from London in a sailing-ship, and these were landed at Lyttelton. Four years later the Canterbury Acclimatization Society brought over some silver-carp from Sydney. In 1867 the Auckland Society introduced a large number of Prussian carp, and some were placed in Lake Takapuna ; the destination of the others is not stated. Lastly, in 1870 a number of Chinese and Prussian carp were imported into Canterbury. These appear to be the only recorded cases of introduction of these various

fishes, and yet they must have been brought to this country at many different times, for they are now common in many parts, particularly of the North Island.

At the present time one or more of these species are abundant in several parts of the Auckland, Taranaki, and Hawke's Bay Districts, as well as in ponds and lakes in various parts of both Islands. But it is not possible to say, without special examination, to what species they belong. There is work here for our local naturalists to do.

The common carp has a stout, thick body with a rounded snout, and four barbels—one at each angle of the mouth, and a smaller one

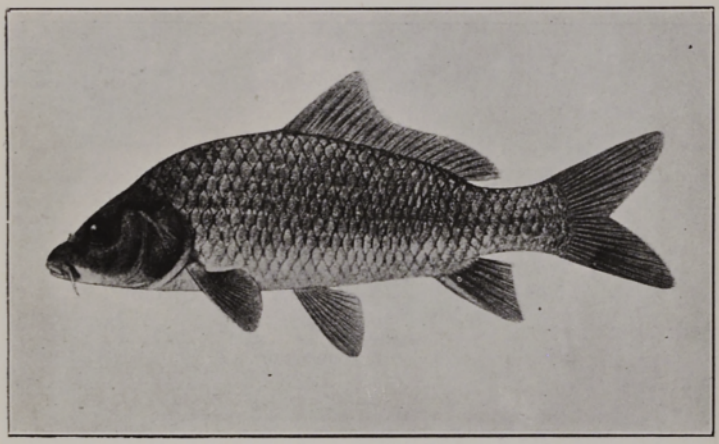


Fig. 35.—The Carp (*Cyprinus carpio*).

between the angle and the snout. It is a very variable species, especially in the characters of scale and fin, but as a general rule the scales are large and well marked, the border of each showing radiating lines ; the dorsal and anal fins have a strong ray which is serrated on the hinder margin ; the tail is forked. The general colour is golden, brown, or yellow, darker on the head and upper parts, with the root of each scale a brilliant brown ; the belly is yellowish-white.

Carp grow to a great age. In Europe they are said to have reached from one hundred to two hundred years, and these old fish are of great size, and weigh as much as 50 lb. Professor Seeley says : "The carp is tenacious of life, and in winter is kept alive in Holland for weeks

by being placed in wet moss which is hung in a net. The fish at first require to be frequently dipped in water, but gradually adapt themselves to the new condition, and feed on bread and milk. The ordinary food of carp consists of larvae of insects, worms, and various water-plants. It has been known to feed on minnows. It becomes tame in the ponds, and readily assembles to take bread or boiled potatoes. In winter it hides in the mud, and passes months without eating. It breeds usually in the third year, but the number of eggs increases with age and in a fish of 10 lb. weight the eggs number seven hundred thousand."

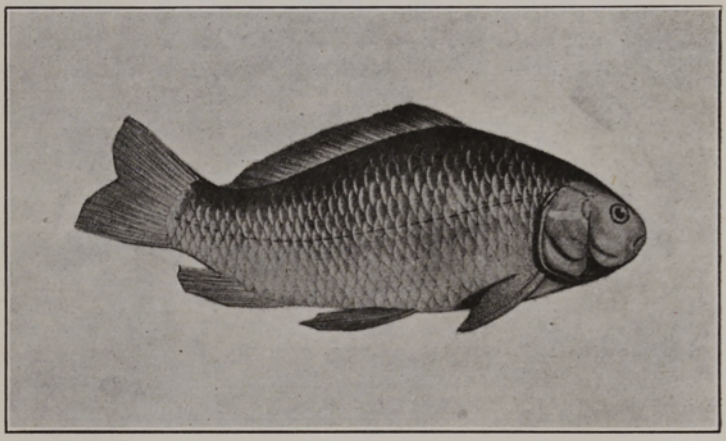


Fig. 36.—The Prussian Carp (*Carassius vulgaris*).

There is no information available as to the habits of the carp in New Zealand. In the author's work on the "Naturalization of Animals and Plants in New Zealand" (at p. 250) some information will be found as to the changes in habit which carp naturalized in America have undergone; it would be interesting to learn whether similar changes have taken place in this country.

Old Izaac Walton says: "The carp is the queen of rivers; a stately, a good, and a very subtle fish," and he gives some interesting suggestions as to how to catch and cook this bony fish. On the Continent of Europe carp are carefully cultivated, and form an important article of food. The Prussian carp is considered by Gunther to be

only a variety of the crucian carp (*Carassius vulgaris*), and it differs, like all other species of the genus, in having no barbels, and in the finely serrated stiff ray in the dorsal and anal fins being rather weak, not strong as in *Cyprinus*. Its scales are large. Like the common carp, it is a naturalized fish in Britain.

Gold and silver fish are very like carp in general form and fin arrangement. They have no barbels round the mouth, and never seem to grow more than 9 in. or 10 in. in length. They have become naturalized in many waters in New Zealand, and are especially abundant about Rotorua.

It is difficult to say of what country this species is a native. It appears to have been a domesticated species in China for centuries and to have spread from there. Both in China and Japan numerous sports or varieties are kept: some with the dorsal fin reduced or absent, the anal fin doubled; others with two, three, or even four tails. It is also very variable in size and colour, some being deep orange or red, others as white as silver, with all sorts of intermediates.

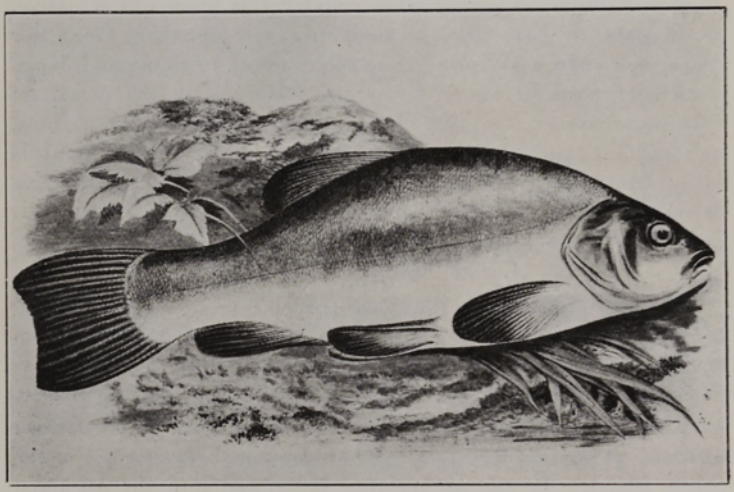
11. The Tench (*Tinca vulgaris*).

This European fish was introduced from Tasmania—where it had become naturalized—by the Canterbury and Southland Acclimatization Societies in 1867–68. It does not seem to have thriven well. It is now met with in ponds and dams in North Otago and South Canterbury, but does not seem to occur in any waters south of the Oamaru district. It is also found in a few localities on the west coast of the South Island. It was at one time introduced into the Auckland District, but seems to have been exterminated by trout. It may occur in other districts, but, if so, it does not seem to be known to the acclimatization societies. I do not know for what purpose it was brought into New Zealand; it is not an acquisition.

The tench is a stoutly built, somewhat deep fish, its back rising abruptly from the snout to the dorsal fin. This fin is slightly behind the middle of the body, and is as wide as it is long, and has from ten to twelve rays. The tail-fin is broad and powerful, but the other fins are all rather short and small. The ventrals, which have from nine to eleven rays, are much larger in the male than in the female; the first ray is short, thick, crooked, and transversely striated. There is a small barbel pendent from each side of the mouth. In colour the

back is a fine rich olive-green to dark brown; the sides are rusty brown or yellowish, and the lower parts lighter. The scales are very small and smooth, and the body is covered with slime to a marked degree. The eye is small and red.

This fish lives in lakes and slowly moving streams, and is itself a slow and rather sluggish fish. It feeds both on animal and vegetable substances, but apparently does not prey on other fish. In winter it buries itself in mud, and only reappears in spring as the temperature of the water rises. It spawns in October and November at no great depth, depositing its eggs on such water-weeds as *Potamogeton* and



[*After Houghton.*

FIG. 37.—THE TENCH (*Tinca vulgaris*).

Myriophyllum. It is a very prolific fish, a female weighing 3½ lb. containing nearly three hundred thousand eggs, which hatch out in two or three days. It grows in Britain to a weight of 4 lb. or 5 lb. They have been taken up to 33 in. in length, and weighing 11 lb. to 12 lb.

Opinions differ as to its edibility. Some consider it a very muddy-tasted fish. Izaac Walton says of it: "This fish loves to feed in very foul water, and amongst weeds. And yet I am sure he eats pleasantly, and, doubtless, you will think so, too, if you taste him."

Many quaint legends have sprung up about this fish and the wonderful cures it can effect. Walton says that "the tench is the physician of fishes, for the pike especially; the pike, being sick or hurt, is cured by the touch of the tench." These stories, which date from a great antiquity, are all mythical. Herbert Maxwell says that the tench has a habit of nibbling at raw and injured parts of another fish, and from this it derives its ancient name of the physician of fishes.

12. American Catfish (*Ameiurus natalis?*).

This ugly-looking fish was imported into Auckland by Mr. T. Russell in 1877, when 140 of them were placed in St. John's Lake. Being fish that stay at the bottom of the water, they were

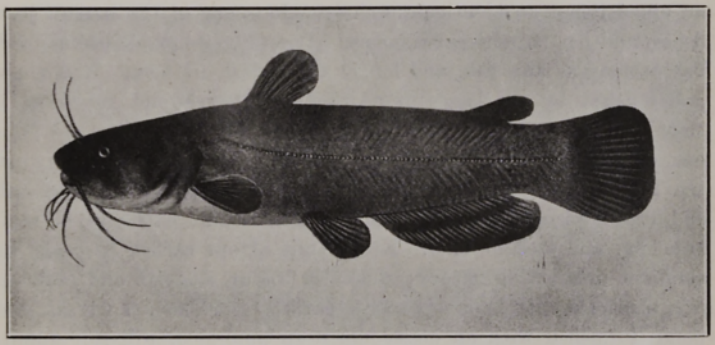


Fig. 38.—The American Catfish (*? Pimelodes cattus*).

lost sight of for some years, but reappeared in considerable numbers in 1884. In the following year they were distributed widely over the Auckland District, while others were sent to Wellington, Canterbury, and the west coast of the South Island. At the present time they occur in St. John's Lake and Lake Takapuna in Auckland, in Lake Mahinapua in Westland, in a few ponds about Christchurch and Ashburton, and probably in several other localities, but very few people know of their existence, as they are seldom in evidence. The name "catfish" has reference to the presence of eight barbels placed round the mouth, which suggest to persons of lively imagination the whiskers of a cat.

They belong to an ancient family of fishes known as the Siluridae, characterized by the absence of scales, and when the skin is not naked it bears bony plates on its surface. They all have barbels round the mouth. The genus *Ameiurus*, to which our introduced species belongs, has eight of these appendages. The palate is without teeth. The adipose and anal fins are of moderate length; the short dorsal fin has a sharp spine and six soft rays, and the ventral has eight rays.

Probably these fish were introduced for their edible qualities, but the popular name is applied to many species of two or three genera, and it is not at all certain that the particular one introduced into Auckland is one of the best species. They are in great demand in parts of America, and are pre-eminently a poor man's fish, because there they are cheap. One authority says of *A. nebulosus*, an allied if not an identical species: "It is one of the best of panfishes, and has no noticeable bones. It retains its excellence as fresh fish as long as any fish, and longer than most of them. It is eaten and relished by all classes of people, and they would eat more if they could get them." Writing of their habits, Dean says: "It is one of the hardiest of fishes, will care for itself and even thrive in the muddiest of stagnant waters. It will breed readily, and will endure complacently every hardship of drought, extremes of temperature, and lack of food. Every trait of our catfish bespeaks its stagnant mud-loving nature; dusky in colour, sluggish and blundering, furnished with long and tactile barbels, a shallow, slowly drained pond, furnished with an occasional deep mud-hole, will suit admirably the needs of the fish. If the water does become warm in the summer the catfish will survive—knowing how to survive is one of its especial virtues. Should the pond dry, and the whole basin be serried with mud-cracks, the catfish will lie dormant for days, even for weeks." In the severe winter of parts of the States they hibernate, and bury themselves in the mud, reappearing in spring. When feeding they prowl along the bottom, with the barbels widely spread, these organs being evidently well provided with sensory nerves. They seem to be more or less nocturnal in their habits. They will usually take fish, frogs, or worms as bait, and are most readily caught about dusk or later.

All species of catfish are said to be very destructive to the spawn of other species. It would therefore be interesting to find out

whether any other kinds of fish are to be found in the ponds or lakes into which these curious fish have been introduced. They are to be found in some localities, and their occurrence and their habits should be investigated. Mr. H. Brett, writing to the Hon. G. J. Garland in September, 1925, says: "Twenty years ago, before the pumping-stations were put up at Takapuna, the lake-water came right into my bathing and boat sheds, and in those days there were generally half a dozen to a dozen catfish swimming over the sand. These were easily caught when fishing for eels in the shallow water. Since the lake receded I have not seen any catfish."

A number of years ago, at different times, small consignments of this species were sent to Europe. They survived transportation very well, and apparently throve after reaching their destination. But I know of no further record of them. The following lines appeared about them in *Punch* at the time:—

The catfish is a hideous beast,
A bottom-feeder that doth feast
Upon unholy bait.
He's no addition to your meal;
He's rather richer than the eel:
And ranker than the skate.

13. The Perch (*Perca fluviatilis*).

Perch were first introduced into New Zealand by the Otago Acclimatization Society in 1868. They were obtained from Tasmania, where they had already become naturalized, having been introduced there from Britain. Later on they were imported into Southland, Canterbury, Wanganui, and Wellington. No doubt also Auckland introduced them, though no record of the fact seems to have been kept. They are now fairly common in ponds and lagoons throughout New Zealand.

The perch is a bold, handsome fish. Izaac Walton says of him: "He has a hooked or hog back, which is armed with sharp and stiff bristles, and all his skin armed or covered over with thick, dry, hard scales, and hath, which few other fish have, two fins on his back." This scaliness is a characteristic of the perch: its scales are large and finely serrated on the free edge, so that the fish is rough to

the touch. The colour of the back is dark olive-green, with lighter and golden-yellow hues on the sides; the belly is pearly-white. Across the body run from five to nine dark bands forming vertical parallel stripes. The first dorsal fin is strongly developed, and has thirteen to fifteen stiff spinous rays, which are greyish-violet in colour, except the membrane of the third posterior ray, which is always deep black. When the fish is fighting or is attacked these spinous rays are always rigid, and then the perch is a prickly morsel for a bigger fish to attempt to swallow. Walton writes: I have told you he is a bold fish, such a one as, but for extreme hunger, the pike will not

[*After Houghton.*

FIG. 39.—THE PERCH (*Perca fluviatilis*).

devour; for to affright the pike, and save himself, the perch will set up his fins much as a turkey-cock will sometimes set up his tail." The second dorsal fin has a short spine, followed by fifteen to sixteen soft blunt rays; its colour is yellowish at the base, blending into green and red. The ventral and anal fins and tail are usually bright red, tending to orange.

The perch is a gregarious fish, which feeds on insects, worms, and smaller fishes. Though the name *fluviatilis* implies that it is found in rivers, it is really much more at home in ponds and lakes. Again to quote Walton, whose charming classic every one interested in

fishes should possess: "As one has wittily observed, if there be twenty or forty in a hole, they may be at one standing all catched one after another; they being, as he says, like the wicked of the world, not afraid, though their fellows and companions perish in their sight. And you may observe that they are not like the solitary pike, but love to accompany one another, and march together in troops." The perch is also a fish of great vitality, and can be kept out of water for hours. In parts of Europe they are taken alive to the markets, packed in wet grass, and if not sold are returned to the ponds from which they were brought.

Perch spawn in still or nearly still water from September to November. The eggs, which are covered with mucus, are produced in long strings like ropes of fine beads, which are attached to water-weeds. The number of eggs produced is very great, ranging from two hundred and fifty thousand to nearly a million. The fish grow very slowly. According to Maxwell, a three-year-old perch measures, on the average, only about 8 in., and weighs 3 oz. In its sixth year it will be about 16 in. long, and weigh 1½ lb. Under favourable conditions the fish may grow to 3 lb. weight; the record weight for Britain is 8 lb., though it is reported that a nine-pounder was once taken out of the Serpentine in Hyde Park, London.

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FE IN NEW ZEALAND. Part II: INTRODUCED BIRDS AND FISHES.—G. M. THOMSON.