

# J

**JABIRU:** *Jabiru mycteria* of South America (not, as stated by Newton with a wrongly titled figure, *Mycteria americana*) ; in the Old World the name is sometimes applied to the Saddlebill *Ephipporhynchus senegalensis* or the Blacknecked Stork *Xenorhynchus asiaticus*. For all these species of Ciconiidae see STORK.

**JACAMAR:** substantive name of species of Galbulidae (Piciformes, suborder Galbulae) ; in the plural, general term for the family. This consists of 5 genera and about 15 species of small or medium-sized birds (5-11 inches long) confined to the wooded portions of continental tropical America, chiefly at low altitudes. Jacamars have long, pointed, usually slender bills. Their legs are short, and in four-toed species two toes are directed backwards ; but in the genus *Jacamaralcyon* only three toes are present, the inner hind toe having been lost. The more typical species have glittering metallic plumage and, with their long thin bills, remind one of overgrown hummingbirds (Trochilidae). Perhaps even more than hummingbirds, they seem charged with intense vitality. They are among the most exciting of all birds to meet.

A widespread and familiar member of the family is the Rufous-tailed Jacamar *Galbula ruficauda*, which ranges from southern Mexico to Ecuador, Brazil, and Trinidad. The upper plumage, including the wings and central feathers of the long tail, is glittering metallic green, over which play golden, coppery, and bronzy glints ; there is a broad green band across the chest, separating the white throat from the rufous-tawny of the posterior under parts and the outer tail feathers. The female differs from the male only in having the throat pale buff instead of white. In both sexes, the long sharp bill is black.

The largest member of the family is the Great Jacamar *Jacamerops aurea*, a long-tailed bird (in all nearly a foot in length) ranging from Costa Rica to the Amazon valley. In the male, the top of the head is bright metallic green, which merges into rich

metallic golden or reddish bronze on the back and shoulders, this in turn becoming bright golden-green on the rump and central tail feathers. The outer feathers of the tail are violet-blue. The sides of the head and the upper throat are metallic green, the lower throat is pure white, and the remaining under plumage is rufous-tawny. The female is like the male except that her lower throat is tawny like the rest of the ventral surface. The bill, which is only moderately long and slightly curved, is black.

A less graceful and glittering representative of the family is the White-eared Jacamar *Galbalcyrrhynchus leucotis* of Amazonia. Its plumage is largely chestnut and, as the name implies, there is a white patch behind each eye. A long, thick, almost white bill and a short tail give it a top-heavy aspect.

Jacamars appear to be wholly insectivorous and, at least in the best known genus, *Galbula*, their prey is captured on the wing. The bird rests on an exposed perch, turning its head from side to side, until it spies a suitable flying insect ; this it then overtakes by means of a rapid sally, making a fine display, especially if the victim is a large, brightly coloured butterfly or a wide-winged dragonfly. Morphos and large swallow-tails *Papilio*, which most flycatching birds eschew, are favourite fare of the jacamars. With the victim fluttering in its slender bill, the captor returns to its perch, against which it beats the insect long and loudly until the brilliant wings flutter earthward, after which the body is eaten. Despite a predilection for large and showy insects, jacamars capture many that are small and inconspicuous.

Although jacamars are closely related to the puffbirds (Bucconidae), their loquacity contrasts with the latter's taciturnity no less than their graceful slenderness with the puffbirds' chunkiness. The Rufous-tailed Jacamar is a noisy bird, and its sharp calls, sounding afar through the woodland, suggest that it lives at a high pitch of excitement. When mated birds are together, and especially when two



males compete for a female, their animated vocal performances include an accelerated series of high-pitched notes that may merge into a long-drawn, clear, soft trill. At its best, the jacamar's song is delightfully melodious.

Jacamars nest chiefly in burrows, which they dig in roadside or streamside banks, in steep wooded hillsides, or in the wall-like mass of clay raised up by the roots of a great tree that has fallen before the wind. Breeding in cavities in termites' nests has been reported for several species of *Galbula*; these include the Rufous-tailed Jacamar, which usually nests in burrows, and this suggests that a termitary is chosen when a suitable site for digging a tunnel is not available. In this species, the burrow is excavated by both sexes. They loosen the earth with their fine-pointed bills, seemingly little fitted for this task, and remove it from the tunnel by kicking vigorously backward as they enter. At one nest, the female did the larger share of the digging, but she was often fed by her mate. The burrows of this species range from about 11 to 18 inches in length, and at the mouth they are from  $1\frac{3}{4}$  to 2 inches in transverse diameter and slightly less in height. At the inner end, the burrow dilates into a chamber, which the jacamars do not line. The same burrow may be used in successive years.

The Rufous-tailed Jacamar lays 2-4 white, glossy eggs; few records are available for other species. The female incubates through the night, while by day she and her mate sit alternately, taking sessions that usually exceed an hour and may last for over three hours. Intervals of neglect are short and the eggs are almost constantly attended. The sitting parents regurgitate many shards of beetles and other chitinous parts of insects, and these accumulate on the floor of the chamber. The period of incubation ranges from 20 to 23 days.

In contrast to the perfectly naked nestlings of most piciform birds, newly hatched jacamars bear copious long whitish down. They are equipped with prominent heel pads that are nearly smooth instead of strongly papillate like those of woodpeckers (Picidae), toucans (Ramphastidae), and other birds that breed in unlined holes in trees. Both parents bring the young a variety of insects, but they fail to remove droppings. As they grow older, the nestlings become noisy, and while they await their meals repeat weak-voiced imitations of their parents' calls, including pleasant little trills. They leave the burrow when 21-26 days of age, wearing plumage much like that of adults of the same sex.

See Plate 32 (colour).

A.F.S.

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Slater, P. L. 1882. A Monograph of the Jacamars and Puff-birds, or Families Galbulidae and Bucconidae. London.

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**JACANA:** substantive name (alternatively 'lily-trotter', especially for the African forms) of the species of Jacanidae (Charadriiformes, suborder Charadrii); in the plural, general term for the family. The name is derived from a Brazilian word and should strictly be pronounced 'jaçaná'. The jacanas constitute a tropical and subtropical family of which the precise systematic position is still obscure. They are extraordinary, long-legged waterfowl of moderate size—mostly 10-13 inches in length, not including the tail plumes in the breeding dress of one species. The length of leg is accentuated by the bareness of much of the tibia. The foot is remarkable—excessively elongated toes and straight claws, with the claw of the hind toe much longer than the toe and tapering to a fine point; this formation of the feet enables the birds to move easily over floating vegetation, the spread ensuring the best distribution of the weight. The sexes are alike, but the females are usually the larger. Rufous coloration or dark bronze tints predominate; the juveniles are rufous-brown above and nearly white below. The adult plumage is usually assumed after two years and, except in *Hydrophasianus*, there is no special off-season plumage. Most species have a frontal shield—red, yellow, or blue; in the juveniles it is rudimentary. The bill is moderately long, straight, and compressed, with the culmen curved at the tip. The wings are rather long, and the tail is short except in *Hydrophasianus*. On the carpal joint there is a small spur or blunt knob; this is sometimes exaggerated into an inch-long spine. During the annual moult *Actophilornis* is flightless for a while, as it sheds its flight feathers simultaneously. In flight some species display a conspicuous light wing-patch.

Insects and all manner of aquatic life, animal and vegetable, form the food, which is taken while the birds move actively over the water plants. The jacanas' walk is rail-like, a deliberate high-stepping action with an accompanying jerk of the tail at each step, but they can run at considerable speed. When skipping from one piece of floating vegetation to another, or when alighting, they momentarily raise their wings perpendicularly, butterfly-wise, above the back. Over short distances the flight appears slow and laboured, although the wing-beats are rapid, and is much hampered by the long hanging



times used as English, for Bennett's Cassowary *Casuarus bennetti* (see CASSOWARY).

**MOPOKE:** popular name, also written 'more-pork', used in Australia for *Podargus strigoides* (see FROGMOUTH), and both there and in New Zealand for subspecies (or related forms) of *Ninox novaeseelandiae* (see OWL). The name purports to represent the call.

**MORILLON:** British fowler's name (probably obsolescent) for immature Goldeneye *Bucephala clangula*, once thought to be a different species (see DUCK).

**MORPH:** term introduced (J. S. Huxley 1955) to replace the less precise 'phase', denoting any one of the different forms of a species population subject to polymorphism (including dimorphism, where there are only two morphs)—see POLYMORPHISM.

**MORPHOLOGY:** literally, the science of form or shape; nowadays commonly extended to cover all external characters, including coloration, or even used synonymously with 'anatomy' (literally, internal structure as revealed by dissection); and it may be applied not only to the study but to its subject matter, as a collective term for the 'morphological' characters of a taxon.

**MORPHOSPECIES:** see under SPECIES

**MORTALITY:** see LIFE, EXPECTATION OF; LONGEVITY; POPULATION DYNAMICS; PREDATION

**MOSAIC EVOLUTION:** see under ARCHAEOPTERYX

**MOSSIE:** or Cape Sparrow, *Passer melanurus* (see SPARROW (1)).

**MOTACILLIDAE:** a family of the Passeriformes, suborder Oscines (see WAGTAIL).

**MOTHER CAREY'S CHICKEN:** sailors' name (from 'Mater cara') for storm-petrels of various species (Hydrobatidae)—see PETREL.

**MOTIVATION:** see DRIVE; and AMBIVALENCE

**MOTMOT:** substantive name of species of Momotidae (Coraciiformes, suborder Alcedines); in the plural, general term for the family. The motmots are allied to the kingfishers (Alcedinidae) and even more closely to the todies (Todidae). The 6 genera and 8 species (*Momotus* and *Electron* have 2 apiece) are confined to continental, tropical America, chiefly at low altitudes. The family is best represented in northern Central America and southern Mexico, where in certain regions of lighter vegetation motmots are abundant and conspicuous. Among the noteworthy structural peculiarities of the motmots are the serrated edges of their broad bills, which are

about as long as their heads and decurved at the end; and their feet, in which the outer toe is united to the middle one for most of its length and only one toe is directed backwards, as in kingfishers.

These beautiful birds ( $6\frac{1}{2}$  to  $19\frac{3}{4}$  inches in total length) are clad in softly blended shades of green, olive-green, and rufous rather than in brilliant spectral colours, although the head is often adorned with bright blue and a black patch is usually present on the chest or throat. The most striking feature of motmots is the tail, which is long and strongly graduated. In typical motmots, the central rectrices far exceed the others in length, and when they first expand the vanes may be narrower in the subterminal region than elsewhere. In this subterminal portion the barbs are loosely attached and fall away as the bird preens, and probably also in consequence of rubbing against the vegetation through which it moves, leaving a length of naked shaft supporting a spatulate or racquet-like tip where the vanes remain intact. The length of denuded shaft varies considerably from genus to genus, and in some genera it is lacking. While perching, motmots often swing their tails, pendulum-wise, from side to side and sometimes hold them tilted sideways. When they about-face on a perch, they lift the tail over it with a graceful flourish.

One of the most beautiful members of the family is the Turquoise-browed Motmot *Eumomota superciliosa*, which is found from southern Mexico to northern Costa Rica in semi-arid country and in clearings in the rain-forest. Well over half of its 14 inches is accounted for by its long tail. As in other motmots, the sexes are alike in coloration. The upper plumage is largely bright olive-green, with a patch of cinnamon-rufous in the centre of the back. Above each eye is a broad band of pale turquoise, the bird's brightest colour. The lores and ear-tufts are black, and on the throat is an elongated, wedge-shaped patch of black bordered on each side with turquoise. The remaining under plumage is greenish-olive and cinnamon-rufous. The middle feathers of the greenish-blue tail have a much greater length of denuded shaft than in other motmots, so that the spatulate, blue and black ends hardly appear to be connected with the rest of the bird; this makes the Turquoise-browed Motmot more airily graceful than its relatives.

The largest member of the family is the Rufous Motmot *Baryphthengus ruficapillus*, which inhabits heavy forests from Nicaragua to Amazonia. This 18-inch bird has the head, neck, and most of the under parts tawny, the back and rump and under tail coverts green. There is a black patch on each side of the head and one in the centre of the chest. Each



of the central tail feathers has a short length of naked shaft. At the other extreme of size is the Tody Motmot *Hylomanes momotula*, an elusive and little-known inhabitant of forests from southern Mexico to north-western Colombia. About  $6\frac{1}{2}$  inches long, clad in dull green and rufous with black ear-tufts, this small motmot has a short tail without racquet tips.

An aberrant member of the family is the Blue-throated Motmot *Aspatha gularis*, which in northern Central America and extreme southern Mexico inhabits forests of oaks, pines, and cypresses from about 4000 to 10 000 feet above sea level, where it resides throughout the year, despite the severe frosts of the winter months. About 11 inches long, this motmot is almost wholly clad in green, but it has black ear-tufts and a black patch in the centre of the foreneck. The feathers of the long tail are strongly graduated, but the central ones have continuous webs rather than racquet tips.

When foraging, motmots perch motionless until their keen eyes detect a beetle, a caterpillar, a spider, a butterfly, or a lizard on the foliage, on the ground or (as regards some of these) in the air. Then they make a swift dart, seize the victim, and carry it back to the perch, against which they usually beat it before gulping it down. Small fruits, plucked while the bird hovers on the wing, vary the diet of some species.

Although the utterances of motmots are all structurally simple, they vary immensely in tone from species to species. The Turquoise-browed Motmot voices a dull, wooden 'cawaak cawaak'. The call of the widespread Blue-diademed Motmot *Momotus momota* is a full, frog-like, not unmelodious 'coot coot'. At dawn, the rain-forest of Panama is filled with the hollow hooting of the Rufous Motmot, a mysterious, ghost-like sound difficult to trace to its source. The most melodious species is the Blue-throated Motmot, of which the delightfully clear and mellow notes are heard chiefly at dawn, when the members of a pair often sing in unison.

Motmots nest chiefly in burrows, which are dug by both sexes (in the species for which information is available). The earth is loosened with the bill and removed by kicking backwards with the feet each time a bird enters to resume digging. In the Turquoise-browed Motmot, the female seems to perform the greater share of the work, but the male sometimes gives her an insect. Often the burrow is in the vertical bank of a watercourse or road, but the Blue-diademed Motmot may dig its tunnel in the side of a mammal's burrow or of a narrow pit in level ground, which makes its nests very difficult to find. In this species, as in the Blue-throated Motmot, the

burrow may be crooked, with one or several sharp turns; but that of the Turquoise-browed Motmot is as a rule only slightly curved. Motmots' tunnels up to 14 feet in length have been recorded, but most are much shorter. Along the bottom of an occupied tunnel are two distinct parallel grooves, made by the birds' short legs as they shuffle in and out. In limestone regions, motmots sometimes nest in caverns or in niches in the sides of wells.

Three or four (rarely more) broad, roundish, pure white eggs are laid on the bare floor of the enlarged chamber at the end of the burrow. They are incubated by both parents, who sit for long periods (up to 6 hours continuously in the Blue-throated Motmot). While incubating, motmots regurgitate many chitinous pieces from their insect food and an occasional seed, all of which are trampled into the floor of their chamber. In the Blue-throated Motmot, the incubation period is 21 or 22 days. Nestling motmots, hatched blind and with no trace of down on their pink skin, are brooded and fed by both parents; but no attempt is made to keep the nest clean. In the Blue-throated Motmot and the Turquoise-browed Motmot, the young leave the burrow when 28-31 days of age; they are then well feathered, much in the pattern of the adults, and fly well, but their stubby tails of course still lack the racquet tips.

Blue-diademed Motmots may begin in autumn to dig the burrows in which they will breed 4-7 months later. Blue-throated Motmots dig their burrows even earlier, in June or July, soon after their young are fledged. These tunnels are soon finished and are then used as dormitories by the constantly mated pair throughout the winter months, when nights are cold and frosty. Even after the eggs are laid in these old burrows in the following spring, both parents continue to sleep with them, as they do with the nestlings. After the latter are fledged, they do not return to sleep in the burrow, but the parents sometimes continue to lodge in it until the new burrow is completed. The motmots of the lowlands, however, appear not to use their burrows as dormitories, and only one parent sleeps with the eggs or young. A.F.S.

See Plate 32 (colour).

Peters, J. L. 1945. Check-list of Birds of the World vol. 5. Cambridge, Mass.

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Skutch, A. F. 1947. Life history of the Turquoise-browed Motmot. Auk 64: 201-217.

**MOULT:** or 'molt' in American usage, the periodic shedding (ecdysis) and renewal (endysis) of plumage, and in some species of certain accessory structures of epidermal origin (see FEATHER;



to affect widely different species (e.g. the Fulmar *Fulmarus glacialis*), as the result of infection by an identical or closely related virus, and therefore sometimes called 'ornithosis' (see DISEASE).

**PSITTIROSTRIINAE:** see HONEYCREEPER (2)

**PSOPHIAE; PSOPHIIDAE:** see under GRUIFORMES; and TRUMPETER

**PSYCHOLOGY:** the scientific study of mental processes; in respect of birds necessarily the study of the manifestations constituting BEHAVIOUR.

**PTARMIGAN:** substantive name of *Lagopus* spp. other than *L. scoticus* and sometimes *L. lagopus*; used without qualification in Britain for *L. mutus*, elsewhere known as the Rock Ptarmigan; in the plural (sometimes unchanged), serves as a general term for the genus (see GROUSE). See Plates 8 and 29 (colour).

**PTEROCLETES; PTEROCLIDIDAE:** see under COLUMBIFORMES; and SANDGROUSE. 'Pterocletes' (P. L. Sclater 1880) is the usual spelling of the subordinal (or ordinal) name, but Newton pointed out that it was based on a grammatical misconception; he preferred 'Pteroclidides' (Sundevall 1836) as a more possible, although not certainly correct, plural of Pterocles. The familial name is sometimes spelt 'Pteroclididae' or 'Pterocletidae'.

**PTERODACTYL:** see WINGS, COMPARATIVE ANATOMY OF

**PTERYGOID:** a paired bone of the skull (see SKELETON; and PALATE).

**PTERYLA:** a feather-bearing area of skin (compare APTERIUM; see PLUMAGE).

**PTERYLOGRAPHY:** delineation of the distribution of feathers on the skin, or the distribution (pterylosis) itself (see PLUMAGE).

**PTERYLOSIS:** the distribution of feathers on the skin (see PLUMAGE).

**PTILOGONATINAE:** see BOMBYCILLIDAE; and SILKY FLYCATCHER

**PTILOGONYS:** generic name often used as substantive name of *Ptilogonys* spp. (see SILKY FLYCATCHER).

**PTILONORHYNCHIDAE:** a family of the Passeriformes, suborder Oscines (see BOWERBIRD).

**PTILOPAEDIC:** clad in down when hatched (see YOUNG BIRD).

**PTILOPODY:** the condition of having feathers on the tarsus and toes (Danforth 1919).

**PTILOSIS:** synonym of PLUMAGE.

**PUAIOHI:** *Phaeornis palmeri* of the Hawaiian Islands (for subfamily see THRUSH).

**PUBIS:** a paired bone (plural 'pubes') of the pelvic girdle, partly fused with the other elements (see SKELETON).

**PUFF-BACK:** substantive name of *Dryoscopus* spp. (see SHRIKE). There are also 'puff-back flycatchers' *Batis* spp. (see FLYCATCHER (1)).

**PUFFBIRD:** substantive name of some species of *Bucconidae* (Piciformes, suborder Galbulae); in the plural, general term for the family. This consists of 10 genera and about 30 species of small or medium-sized birds (5½–10½ inches long) confined to continental tropical America. The puffbirds are closely related to the jacamars (*Galbulidae*). Their large heads, abundant, lax, dull-coloured plumage, and short tails make them appear stout and 'puffy', whence their name. The bill, of short or medium length and often notably stout, is decurved or hooked at the tip. The feet are zygodactylous, with two toes directed backwards. The family is best represented in the Amazon valley and Colombia, and it is largely confined to the warm lowlands.

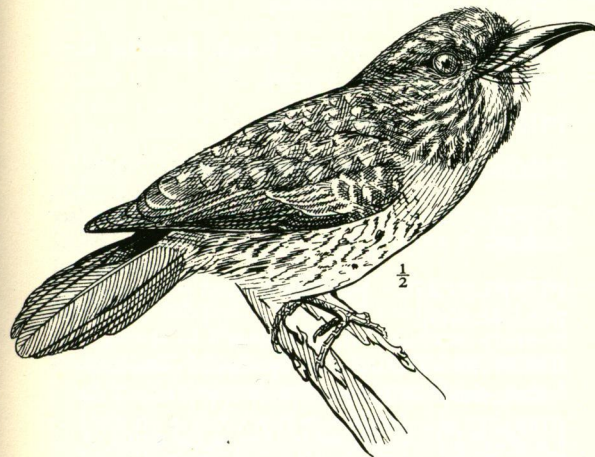
One of the largest and most widespread members of the family is the White-necked Puffbird *Notharchus macrorhynchus*, which ranges from southern Mexico to Amazonia. This handsome bird is about 9½ inches in length. Both sexes are largely black on the dorsal surface; the forehead, nuchal collar, sides of the head, and under parts are white, with a broad black band across the breast. The thick tapering bill is black.

Slightly smaller is the White-whiskered Softwing *Malacoptila panamensis*, which is found from southern Mexico to western Ecuador. The male is clad largely in chestnut-brown and cinnamon, with the posterior under parts pale buff or nearly white. Both above and below the female is more olive and greyish. Both sexes are liberally spotted and streaked with tawny and buff on the upper parts and streaked with brown and dusky on the breast and sides. Both sexes wear the long, slender, slightly curved, white, malar tufts which are indicated by their name. Their large eyes are dull red.

Both the White-necked Puffbird and the White-whiskered Softwing are found singly or in pairs, or sometimes in family groups of three or four, but never in flocks. The bird rests motionless for long



periods on a more or less exposed lookout perch, apparently lethargic but actually keeping a sharp watch for suitable food. By means of a surprisingly sudden dart, it snatches a caterpillar, winged insect, spider, or small lizard from a neighbouring bough, or sometimes it drops down to seize it among low herbage; then it carries the prey back to a perch to devour at leisure.



White-whiskered Puffbird *Malacoptila panamensis*.  
C.E.T.K.

A very different type of puffbird is the Swallow-wing *Chelidoptera tenebrosa*, widespread in South America. This is a stout, large-headed bird about 6 inches in length; its long wings when folded reach almost to the end of its short tail. Both sexes are largely black or almost black, with a patch of white on the lower back and rump. The abdomen is rufous-chestnut, paling to white on the under tail coverts. The voyager along the Amazon and its great tributaries often sees these graceful little birds perching in pairs on the topmost naked twigs of tall riverside trees, whence they make long, spectacular darts to snatch insects from the air, much in the fashion of some of the bigger American flycatchers (Tyrannidae).

Because of their very plain attire, puffbirds of the genus *Monasa* are called 'nunbirds'. The Black-fronted Nunbird *M. nigrifrons* of the Amazon valley is about 7 inches long. In both sexes, the upper plumage, wings, and tail are dull black and the ventral surface is dark grey. The bill, which tapers from a broad base to a sharp point, is bright orange—whence the name 'pico de lacre' ('sealing-wax bill') sometimes applied to birds of this genus. More gregarious than other puffbirds, nunbirds travel in small flocks.

The Grey-cheeked Nunlet *Nonnula frontalis* repre-

sents a genus of small puffbirds, about  $5\frac{1}{2}$  inches in length. Both sexes are plain brown above and ochraceous or tawny below. This species inhabits the lowlands of eastern Panama and Colombia and little is known of its habits.

Puffbirds are habitually silent, and the notes which they sparingly utter are low and weak. The loudest utterance of the White-whiskered Softwing is a high, thin whistle or 'peep'. The Swallow-wing has a weak, appealing whistle; and the Black-fronted Nunbird utters soft, musical murmurs. As they call, puffbirds often twitch their tails from side to side.

The breeding habits of puffbirds are poorly known, but two types of nests have been discovered: cavities that they carve in the hard, black arboreal nests of termites, and burrows in the ground. In the Black-breasted Puffbird *Notharchus pectoralis* the male and female take turns at digging into a termite. In the side of the large roughly globular structure they make with their bills a narrow horizontal tunnel, which at its inner end expands into a neatly rounded chamber on the hard floor of which the eggs rest, no soft lining being provided for them.

Burrows of the White-whiskered Softwing have been found in gently, or at times steeply, sloping ground in the forest. From a round opening in the leaf-strewn ground, the tunnel descends with a slight inclination for about 20 inches. At the lower end it widens into a chamber that is lined on the bottom and sides with brown dead leaves. Around the opening of the burrow, which is flush with the ground, the birds arrange twigs, petioles, and the like, to form a low collar through which they enter and leave and which makes the aperture less conspicuous. This feature is far more strongly developed in the Black Nunbird *Monasa nigra* of Venezuela, which above the entrance to its descending burrow in level ground raises a large pile of coarse dead sticks; the birds reach their burrow by means of a rounded tunnel that runs along the surface of the ground beneath the heap of sticks. The Swallow-wing, however, places no sticks or other material around the entrance to its burrow, which may be in a bank or in level ground. Like the tunnels of other puffbirds, those of the Swallow-wing are inclined downwards and straight; but they are longer than those of other species—up to 80 inches in length. The eggs rest on a slight lining of dry grass.

Puffbirds lay 2-3 white, glossy eggs that resemble the eggs of woodpeckers (Picidae). These are incubated by both parents, at least in the Black-breasted Puffbird and the White-whiskered Soft-



wing. The latter incubates according to a simple but unusual schedule ; the male sits continuously from the early afternoon to the following dawn ; the female takes one long session of five hours or more in the forenoon ; and the eggs are unattended for half an hour or more between these sessions. Black-breasted Puffbirds take shorter sessions, entering and leaving the nest a number of times in a day. The incubation period is unknown.

Newly hatched puffbirds are blind and perfectly naked, without natal down. In the White-whiskered Softwing, the only species for which details of parental care are known, the male parent does all the brooding and the duller female nearly all the feeding, an arrangement that may have some slight protective value. When only a day or two old, the blind nestlings move up the tunnel to take food from their mother at the burrow's mouth. After the father ceases to brood by night, the nestlings—now with open eyes and becoming feathered—at nightfall somehow raise up the fragmented leaves from the bottom of the chamber to form a screen between themselves and the entrance tunnel. They leave the burrow at the age of 20–21 days, when they are well feathered and have 'whiskers' like their parents.

A.F.S.

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Skutch, A. F. 1958. Life history of the White-whiskered Softwing *Malacoptila panamensis*. Ibis 100 : 209–231.

**PUFFIN**: substantive name of *Fratercula* spp., *Cerorhinca*, and *Lunda* (see AUK) ; used without qualifica-

tion, in Britain, for the sole Atlantic species, *F. arctica*. See Plate 29 (colour).

**PUFFINOSIS**: name given to a disease of the Manx Shearwater *Puffinus puffinus*, probably allied to psittacosis and sometimes causing heavy mortality among the young birds (see PSITTACOSIS).

**PUFFLEG**: substantive name of *Eriocnemis* spp. (for family see HUMMINGBIRD).

**PULLET**: an immature female domestic fowl (which may lay infertile eggs).

**PULLUS**: see under YOUNG BIRD

**PULMONARY ARCH**: see VASCULAR SYSTEM

**PUPIL**: the opening in the iris of the eye (see VISION).

**PURPLETAIL**: *Metallura williami* (for family see HUMMINGBIRD).

**PYCNONOTIDAE**: a family of the Passeriformes, suborder Oscines (see BULBUL).

**PYGOPODES**: formerly used as the name of an order which embraced the present Gaviiformes and Podicipitiformes (or Podicipediformes) and originally also the Alcae.

**PYGOSTYLE**: the fused caudal portion of the vertebral column (see SKELETON).

**PYLORIC ORIFICE**: the exit of the gizzard into the duodenum (see ALIMENTARY SYSTEM).

**PYRRHULOXIA**: generic name used as common name of *P. sinuata* (see CARDINAL-GROSBEAK).

**PYRRHULOXIINAE**: see EMBERIZIDAE ; and CARDINAL-GROSBEAK



branches, they fall to the lower ones or to the ground and there perform various evolutions among themselves; if they perceive the observer they depart with one accord. The Grey-crested Helmet-shrike *P. poliophila* is a close but somewhat rare relative, with a limited range in Kenya and Tanganyika.

With richly coloured eyes, caruncles, bill, and feet, the Red-billed Shrike *Sigmodus caniceps* and Retz's Red-billed Shrike *S. retzii* are very handsome birds found over much of Africa. The Chestnut-fronted Shrike *S. scopifrons* occurs only in East Africa, from north of Mount Kenya to the extreme east of Southern Rhodesia; its blue caruncles contrast strikingly with the red bill.

**Bristlehead.** The monotypic subfamily Pityriasiinae is very doubtfully placed among the shrikes, despite the character of its bill. The sole species, the Bornean Bristlehead *Pityriasis gymnocephala*, is restricted to Borneo. It is about 10 inches long and has mostly sombre plumage, relieved by scarlet on the head and throat; the head is partly naked and warty, and the feathers on the rest of the head and throat are modified in the form of stiff bristles. This species has also been called 'Bald-headed Wood Shrike'.

See Plate 20 (colour).

G.G.O.

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**SHRIKE, ANT-:** see ANTSHRIKE; and ANTBIRD

**SHRIKE-BABBLER:** substantive name of *Pteruthius* spp. (see BABBLER).

**SHRIKE, BUSH-:** see BUSH-SHRIKE; and SHRIKE. Also used as substantive name in some genera of Formicariidae (see ANTBIRD).

**SHRIKE, CATTERPILLAR-:** see CUCKOO-SHRIKE

**SHRIKE, CROW-:** see CROW-SHRIKE; and MAGPIE (2)

**SHRIKE, CUCKOO-:** see CUCKOO-SHRIKE

**SHRIKE, FLYCATCHER-:** see CUCKOO-SHRIKE

**SHRIKE, HELMET-:** see SHRIKE

**SHRIKE, PEPPER-:** see PEPPER-SHRIKE

**SHRIKE, SONG-:** see SONG-SHRIKE; and MAGPIE (2)

**SHRIKE, SWALLOW-:** see WOOD-SWALLOW

**SHRIKE-THRUSH:** substantive name of *Coluricincla* spp. (see THICKHEAD).

**SHRIKE-TIT:** substantive name, in Australia, of *Falcunculus* spp. (see THICKHEAD).

**SHRIKE, VANGA:** see VANGA

**SHRIKE-VIREO:** substantive name of species of the subfamily Vireolaniinae of the Vireonidae (Passeriformes, suborder Oscines); in the plural, general term for the subfamily. The shrike-vireos constitute a small group of arboreal song-birds confined to the forested region of continental tropical America. The 2 genera and 3 or 4 species are by some systematists placed in a separate family, Vireolaniidae, but are now more usually included, as here, in the Vireonidae. The shrike-vireos differ from the typical vireos in having a heavier bill, which is hooked at the tip (see VIREO; also PEPPER-SHRIKE).

The Chestnut-sided Shrike-vireo *Vireolanus melitophrys*—the only member of its genus—is a stout, long-tailed bird nearly 7 inches in length. Its upper plumage is plain olive-green, with the hindneck and top of the head slate-grey, bordered on each side by a broad yellow superciliary stripe below which is a black band from the lores to the ear coverts. The ventral plumage is white, with prominent black malar stripes and a chestnut band crossing the breast and continuing along the sides and flanks. This rare and little-known bird is found, chiefly in the oak forests, from southern Mexico to Guatemala, and from about 4000 to 10 000 feet above sea level. It forages, often in pairs, amid the foliage of trees, where it moves slowly and deliberately, peering from side to side, sometimes hanging upside down to pluck a morsel from the foliage. It holds larger insects beneath a foot while it tears them apart with its strong bill. Among its notes are a low, nasal rattle and a peculiar, long-drawn, high-pitched, far-carrying, whistled screech. No information on the nesting of any species of shrike-vireo appears to be available.

The 2 or 3 species of *Smaragdolanus* (formerly



called 'greenlets') range through the heavier forests at low altitudes, from Mexico to Bolivia. The Green Shrike-vireo *S. pulchellus* is slightly over 5 inches in length. Its upper plumage is bright parrot-green with (in the northernmost race) the top of the head largely cerulean blue. The throat is yellow and the remaining under parts are light yellowish-green. This bird lives high up in the great trees of the Central American lowland forests, where it advertises its presence by its loud, clear, tirelessly repeated whistles; these are grouped in trios, as though the bird counted rapidly 'one-two-three'. Seldom seen, it remains a bird of mystery. A.F.S.

**SIBIA:** substantive name of *Heterophasia* spp. and *Crociast albonotatus* (see BABBLER).

**SIBLING SPECIES:** two or more closely related species that are morphologically very similar but are reproductively isolated (i.e. able to inhabit the same area without interbreeding); sometimes called 'cryptic species'.

**SICKLEBILL:** sole or substantive name used for various species possessing the form of bill suggesting it; these belong to several widely separated families. Thus, it is the name of *Falculea palliata* (see VANGA) and of *Hemignathus procerus* (see HONEYCREEPER (2)), the latter alternatively called 'Akialoa'. Again, it is the substantive name of *Drepanornis* spp. and *Epimachus* spp. (see BIRD-OF-PARADISE), and also of *Eutoxeres* spp. (see HUMMINGBIRD). Further, it has been used (but 'scythebill' is now preferred) as the substantive name of *Campylorhynchus* spp. (see WOODCREEPER); and it is sometimes applied, in Australia, to the White Ibis *Threskiornis molucca* (see IBIS).

**SICKLES:** term (plural) sometimes applied to elongated central tail feathers, found in certain species (see TAIL).

**SIEGE:** see ASSEMBLY, NOUN OF

**SIGHT:** see VISION

**SIGNAL:** see DISPLAY; RELEASER

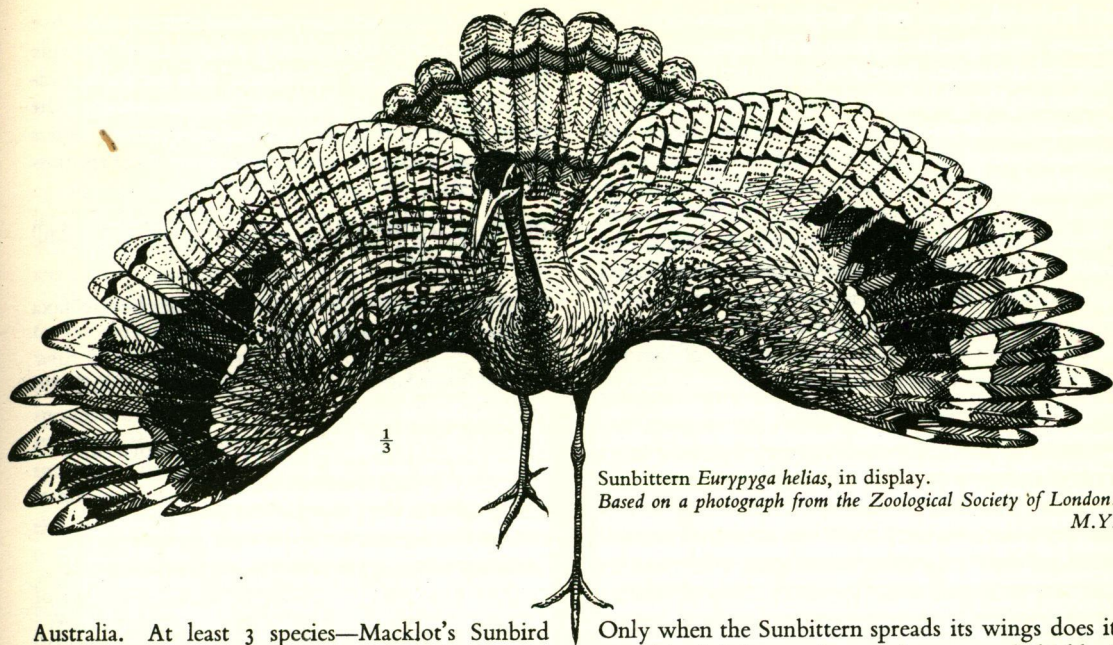
**SIGNIFICANCE:** see STATISTICAL SIGNIFICANCE

**SIGN STIMULUS:** term coined by E. S. Russell to indicate those parts of the available environmental information to which an animal responds at any given moment, particularly when these are strikingly limited. One sees the first indications of this restriction to a few stimuli in observations of astonishing errors, such as a Herring Gull *Larus argentatus* chick

pecking at a cherry in the way in which it does at its parent's red bill-tip; or waders (*Charadrii*) panicking when another wader descends in a wildly swooping flight, thus showing roughly the same type of movement as a striking Peregrine *Falco peregrinus*; or aggressive or sexual responses to animals only remotely similar to the adequate objects. Such 'errors' are in curious contrast to other evidence demonstrating the wonderful acuteness of a bird's perceptive abilities, and this apparent paradox has led to experiments in which the potentialities of the sense organs were compared with the actual stimulus situations releasing particular responses. In birds, the majority of papers on this subject deal with visible stimuli. The potentialities of the eyes are studied with as great a variety of methods as possible: by studying conditioned responses of the intact animal, by observing pupillary reactions, by electrophysiological recordings in or behind the retina, and so on. There is now much evidence to show that the visual acuity of birds is high, that they can recognise forms well, and that their discrimination of intensity and colour is of the highest order (see VISION). Observations on geese (*Anser* spp.), gulls (*Larinae*), crows (*Corvidae*), and other birds have shown that they can distinguish between individuals of their own species much better than even a highly trained human observer.

Actual stimulus situations releasing a particular response have been studied by means of tests with dummies. In these, precise imitation of the natural object normally releasing the response (the standard dummy) is offered in alternation with dummies lacking one or more characteristic, and the intensity or frequency of the response to these various dummies is compared. If there is no or little difference of effect between the standard dummy and one of the incomplete dummies, the character lacking in the latter can be of no or little importance as a stimulus; if the difference is striking, this is indicative of a sign stimulus. There are indications that the difference between a sign stimulus and a non-effective aspect of the environment is often one of degree only. In this way it was found, for instance, that the red patch on an adult Herring Gull's lower mandible is effective in releasing the chick's begging response, whereas the yellow of the rest of the bill is no more effective than any other colour, and this is expressed by saying that the red patch provides a sign stimulus. Further tests showed that it acts by its colour as well as by its contrast with the rest of the bill. Similarly, dummy tests with Song Thrush *Turdus philomelos* nestlings revealed that one of the sign stimuli is provided by the parent's head, which acts through being a protuberance of the outline of the body—above the





Sunbittern *Eurypyga helias*, in display.

Based on a photograph from the Zoological Society of London.  
M.Y.

Australia. At least 3 species—Macklot's Sunbird *Chalcostetha chalcostetha*, Van Hasselt's Sunbird *Leptocoma brasiliana*, and the Black Sunbird *L. sericea*—represent the family in the Far East, one or other occurring in Borneo, the Philippines, the Celebes, the Moluccas, New Guinea, and the Bismarck Archipelago.  
D.A.B.

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**SUNBIRD, FALSE:** name sometimes applied to *Neodrepanis* spp. (see under **ASTRY**).

**SUNBITTERN:** *Eurypyga helias*, sole member of the family Eurypygidae (Gruiformes, suborder Eurypygae). It is found in the forested regions of America from southern Mexico to Bolivia and central Brazil and is represented by 3 currently recognised races. About 18 inches in length, this graceful, stout-bodied, long-necked, long-legged, largely ambulatory bird is most intricately barred, spotted, and mottled. The sexes are alike. The head is almost black, with a narrow white superciliary stripe and a broader white stripe along the lower edge of the cheeks. The neck, shoulders, and breast are brown. The throat, abdomen, and under tail coverts are white and pale buff. The remaining plumage is largely grey and olive in general tone, with prominent black bars and white spots; and the long tail is crossed by two broad black bands.

Only when the Sunbittern spreads its wings does it reveal its brightest colour, a large round shield of deep orange-chestnut set in the midst of an area of pale orange-buff in the middle of each wing, like a sun darkly glowing in a sunset-tinted sky. The upper mandible of the long straight bill is largely black and the lower is orange. The eyes are deep red, and the long naked legs are bright orange.

Singly or in pairs, Sunbitterns forage along watercourses that traverse the forests, up to an altitude of 3000 feet or more above sea level. With slow, sedate steps, they walk along the muddy shores of sluggish streams and over the exposed rocks in rushing mountain torrents, where they fly across the deeper pools but wade through shallow water. They also frequent swampy areas in woodland. Their food, which consists largely of insects, small crustacea, minnows, and the like, is caught beneath shallow water or gathered from exposed mud and rocks. Generally silent, the Sunbittern is reported to utter a soft, long-drawn whistle or plaintive piping.

From the nature of their habitat, it seems that Sunbitterns must pass most of their lives in the shade, but they are said to seek sunny openings in the forest, where they sometimes display. Widely spreading their wings with the richly coloured upper surface tilted forward, they fan out the raised tail to fill the gap between them, thereby forming a semicircle of plumage in the midst of which the head stands.

Although there are reports of Sunbitterns breeding on the ground, usually the nest is built in a tree



or bush. A nest beside a Costa Rican mountain stream was precariously saddled upon a 2-inch branch about 20 feet above the ground. The dark, roughly globular structure, about 12 inches in diameter, was composed of decaying leaves and stems, some green moss, and apparently also mud. In the top of the bulky mass was a shallow depression lined with green leaves, on which 2 eggs rested. This appears to be the usual number. The nearly oval eggs are buffish or clay-coloured with darker spots and blotches. The most complete account of the nesting of this bird is that of a pair which bred in the gardens of the Zoological Society of London almost a century ago. Both sexes built the nest of vegetable materials and mud, and they alternately incubated an egg which hatched after 27 days. The newly hatched young was thickly covered with short down and resembled the chicks of plovers (Charadriidae) and snipe (Scolopacidae). Fed by both parents with food carried in the bill, it remained in the nest until, at the age of 21 days, its wing feathers had expanded and it could fly to the ground. It is remarkable that, although the young Sunbittern resembled a precocial chick, it was attended like an altricial nestling; but it is not known whether the behaviour of this captive pair was typical.

A.F.S.

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**SUNGEM:** *Heliactin cornuta* (for family see HUMMINGBIRD).

**SUNGREBE:** see FINFOOT

**SUNNING:** see FEATHER MAINTENANCE

**SUPERCILIARY:** term applied to a marking, in some plumage patterns, above the eye.

**SUPERFAMILY:** see under FAMILY; NOMENCLATURE; TAXON

**SUPERORDER:** see under CLASS; TAXON

**SUPERSPECIES:** a grouping of species, of lesser rank than a subgenus and having no nomenclatural status; the term was introduced by Mayr (1931) and defined as a 'monophyletic group of very closely related and largely or entirely allopatric species'. It is implied that the included species are geographical representatives of a common stock,

but have at least probably attained true reproductive isolation and are not merely subspecies of a single polytypic species. 'Artenkreis' is a partly equivalent term. A 'species-group' (in one sense of the term) differs in that the included species may be less closely related and often sympatric (see SPECIES-GROUP (2)).

**SUPRAOCCIPITAL:** a paired bone of the skull (see SKELETON).

**SUPRASPECIFIC:** general term applied to taxa higher than the species (see TAXON).

**SURANGULAR:** a paired bone of the lower jaw (see SKELETON).

**SURFBIRD:** *Aphriza virgata* (see SANDPIPER).

**SUTHORA:** former generic name sometimes used, in the plural, as a general term for the Paradoxornithidae (see PARROTBILL).

**SWALLOW:** substantive name of most species of Hirundinidae (Passeriformes, suborder Oscines); in the plural, general term for the family. The only other substantive name used is 'martin'; the distinction has little significance, and there is an instance in which, on different sides of the Atlantic Ocean, both names are applied to the same species (*Riparia riparia*, see later).

**Taxonomy.** The swallows have been described as, taxonomically, the best-defined family in the Oscines; they have the anatomical peculiarity of more or less complete bronchial rings, as compared with half rings with a membrane across the inner face as in other families of the Oscines. They are also among the birds popularly best known. Only in respect of the African River Martin *Pseudochelidon eurystomina* can the propriety of its inclusion be questioned; this bird, differing inter alia in its bronchial rings, is usually segregated in a subfamily of its own, Pseudochelidoninae (the rest being Hirundininae), and even so with the reservation that it may not belong to the family at all. Of the true swallows, Peters recognised 19 genera and 78 species, many of the latter polytypic. This classification is followed here; but the tendency nowadays is to reduce the number of genera.

**Distribution.** The distribution of the group is cosmopolitan, only the highest latitudes and some oceanic islands being without swallows; New Zealand has none, apart from occasional vagrant individuals of an Australian species, and Madagascar appears to have only 2 breeding species despite the particularly abundant representation of the family on the African continent.



the House Bunting *Emberiza striolata* is a remarkably tame bird, feeding inside houses.

There are also some interesting geographical differences in this respect within a single species, and these are not easily explicable. Thus the Robin, already mentioned as being so tame in Britain, is a shy woodland bird over much of Continental Europe, including countries in which it is subject to no persecution. Likewise, the Moorhen *Gallinula chloropus* readily becomes accustomed to man in the populous areas of Britain and some other parts of western Europe, but is elsewhere a notably timid bird. In North America, the Florida race of the Scrub Jay *Aphelocoma coerulescens* is described as bold and confiding, and the Great Basin race as furtive and shy.

As regards tameness acquired by individuals, it was pointed out by Edward Grey (Viscount Grey of Fallodon) that birds became tame in relation to places rather than persons; he instanced the behaviour of the same individual ducks *Anas* spp. towards the same people at different points on his lake. The present writer has had eight Speckle-fronted (or Scaly-fronted) Weavers *Sporopipes frontalis* come unhesitatingly on his hand, outstretched with crumbs, on the verandah of a house in Tanganyika that he had never visited before but where the hostess regularly fed the birds.

It is better to discount as exceptional those cases in which a human being has taken more than usual pains to win the confidence of a wild bird or birds, thus establishing something like a personal relationship (cf. L. Howard). Sometimes there may even be an abnormal factor in that the bird has become conditioned to accept a certain person as a substitute mate or parent (see IMPRINTING). One has also to allow for possible differences in temperament between individual birds of the same species (see INDIVIDUAL VARIATION). Residual tameness on the part of a bird that has been released from captivity is also outside the general picture considered here.

Further, it is necessary to distinguish boldness from tameness—the urge to continue sitting on eggs, or to remain with the young, or to seize prey, is for the time being stronger than the urge to flee. That there may be little real toleration in such cases is shown by the fact that in some species the passive role can give place to an attack on the human intruder; also by the fact that an incubating bird may desert its nest permanently if its capacity for sitting tight is strained to breaking point.

Of the acquisition of tameness by a local population of a species, habituated to human presence in places where no hostile action towards birds ever

occurs, there can be no better example than the Wood Pigeon *Columba palumbus*—so wild and wary in the countryside, so extremely tame in the public parks of London. It was noticed that during the Second World War, when steps to keep down these birds were taken, the degree of tameness became much less; but it has since become re-established.

There are some interesting points about the tameness or otherwise of young birds, including those reared in captivity. Interpretation is difficult, however, in the absence of controlled experiments. For the question of habituation see under LEARNING.

Wild birds, like various other animals, show little fear of vehicles, and can often be approached much more easily in a motor car than on foot. The shape of the vehicle apparently evokes no predator response.

A.L.T.

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**TANAGER:** substantive name of species of Thraupinae (=Tanagrinae) and, in the plural, general term for the group—here treated as a subfamily of the Emberizidae (Passeriformes, suborder Oscines), but in the past usually given separate familial rank. The name comes from 'tangará' in the language of the Tupi Indians of Brazil. The tanagers are 9-primaried song-birds, confined to the Western Hemisphere and very largely to its tropical portion. Systematists now tend to include in this subfamily certain genera of honeycreepers (Coerebinae), but for the time being it is convenient to keep separate these small birds with bills and tongues highly modified for drawing nectar from flowers (see HONEYCREEPER (1)). The so-called Thrush-tanager *Rhodinocichla rosea*, a ground-feeder, seems to be uncertainly included among the tanagers. With these exclusions, the family contains 200 species.

**General Characteristics.** The tanagers, ranging in size from under 4 to over 8 inches in length, contribute more than any other family to the brilliant colour displayed by tropical American birds; although hummingbirds (Trochilidae) are more numerous in species and individuals, they are smaller and their bright metallic colours can be appreciated only under special conditions. For variety of colours and diversity of patterns, the



small tanagers of the genus *Tangara* are outstanding even in this highly endowed family. One of the most gorgeous of these is the Red-rumped Paradise Tanager *T. chilensis*, the 'Siete colores' of the South Americans. This 5-inch bird has the head golden-green; the upper plumage is largely black, with a bright red rump; the chin and throat are light purple, and the remaining under plumage is chiefly turquoise blue. The sexes are alike, as seems to be true throughout this brilliant genus, in which adults wear the same bright colours at all seasons.

The genus *Tanagra* (name not to be confused with '*Tangara*') likewise contains a number of small and colourful species, the 'euphonias'. Less varied in coloration than the aforementioned group, the males are mostly black glossed with violet, blue, or green on the upper parts and sometimes also on the throat; the forehead and more or less of the crown, and the under parts, are chiefly bright yellow. Female euphonias are usually greenish and yellowish, far duller than the males. *Ramphocelus* is a genus of larger and stouter tanagers, of which the males, but not the females, are brilliantly attired. In the Scarlet-rumped Tanager *R. passerinii* of Central America, the male is everywhere velvety black except for the vivid rump, but the female is clad in shades of brown and olive. In the widespread Blue Tanager *Thraupis episcopus* both sexes have blue-grey body plumage with bright sky-blue wings and tail, and in some races there is a large white patch on each wing.

In the Summer Tanager *Piranga rubra* of the southern United States, the male is all red and the female is yellowish. In the Scarlet Tanager *P. olivacea*, which breeds in the United States and Canada, the male is brilliant scarlet with black wings and tail. It is of interest that the most migratory species in a generally non-migratory family is the only one known to undergo pronounced seasonal changes in coloration; in the months of the northern winter, which the species spends in South America, the males are clad in green and yellow, much like the females. In the Western Tanager *P. ludoviciana*, which breeds on the Pacific side of temperate North America and migrates to Central America in the winter, the annual changes of the males are far less pronounced. See Plate 7 (colour).

Among the less usual types of coloration in this extremely varied family may be mentioned the Magpie Tanager *Cissopis leveriana*, widely distributed in South America, in which both sexes are largely white, with the whole head, upper back, and breast blue-black. The wings and the long, graduated tail of this large tanager are black and white. In the Golden-green Tanager *Chlorochrysa calliparaea* of

the eastern foothills of the Ecuadorian Andes, both sexes are largely brilliant metallic green, with a bright orange spot on the crown, a metallic orange patch on the rump, and a black gorget bordered with orange. In the bush-tanagers of the genus *Chlorospingus*, the prevailing colour is olive-green, sometimes with white or nearly black marks on the head. These plain little tanagers are found chiefly in the high mountains, where also a few brilliant species occur; but the family is best represented at low and middle altitudes.

**Voice.** The tanagers as a whole are poorly endowed with song, and this is especially true of the most brilliant genus, *Tangara*, some of the members of which are quite devoid of melody. A few species in other genera have pleasing songs, among them the Scarlet Tanager, Grey-headed Tanager *Eucometis penicillata*, and the ant-tanagers of the genus *Habia*, which sing most persistently at dawn; but no member of the family seems to be a first-class musician. The poorly developed voice in many tanagers appears to be correlated with weak territorial defence or absence of territoriality.

**Habits.** Relatively few tanagers dwell in the dark depths of heavy forest. Many wander through the upper levels of the forest, and like other treetop birds they may forage and even nest in the scattered trees of neighbouring clearings and plantations. Many tanagers inhabit low, bushy growth, but no undoubted member of the family is known to forage over the ground. Tanagers as a whole are largely frugivorous, but probably all of them vary their diet with insects, which are sometimes captured on the wing—especially by the Summer Tanager. This species also frequently tears open nests of small wasps to extract larvae and pupae. Grey-headed Tanagers follow army ants in company with ant-birds (Formicariidae), woodcreepers (Dendrocolaptidae), and many other small forest dwellers, capturing the insects and spiders driven from concealment by the hunting ants, rather than the ants themselves. The euphonias feed largely on the fruits of mistletoes (Loranthaceae), the seeds of which pass through the alimentary tract enclosed in a viscid envelope that attaches them to trees, so that these birds are probably the chief disseminators of the parasites (see POLLINATORS AND DISTRIBUTORS). Tanagers are readily attracted to feeding trays where bananas are provided, and over the years 10 kinds have visited a single tray in southern Costa Rica.

Tanagers roost in trees and bushes, never in holes so far as is known. Mated individuals rest a few feet or yards from their partners rather than in contact with them. At times a number of pairs



gather to roost in an attractive tree. In a number of species the birds remain mated throughout the year, but others travel in flocks in which pairs are not evident. In those that are constantly mated, the male sometimes gives food to his partner, especially as the breeding season approaches. Nuptial feeding has been observed in species of *Tangara*, *Thraupis*, *Eucometis*, *Piranga*, *Tanagra*, and *Chlorophonia*.

**Breeding.** Most tanagers build open cup-shaped nests, high in trees, in low bushes, very rarely on the ground; no species is known to build habitually on the ground. Euphonias and chlorophonias are exceptional in constructing covered nests with an opening in the side, sometimes placing them in a cranny in a post or tree, or even in a tunnel in the ground. The Palm Tanager *Thraupis palmarum* builds its cup-shaped nest in a hole in a tree or other cranny. The Blue Tanager *Thraupis episcopus* sometimes wrests a nest from a smaller bird and hatches its eggs and feeds its young along with those of the dispossessed builder. The nest is constructed by both sexes in numerous species of *Tangara*, *Thraupis*, *Eucometis*, *Tanagra*, and *Chlorophonia*; by the female alone in *Ramphocelus* and *Piranga*.

Tanagers' eggs may be bright blue, blue-green, blue-grey, grey, cream, or white, and they are nearly always spotted, blotched, or scrawled with brown, lilac, or black. They seem usually to be laid early in the morning, before or soon after sunrise. The set usually consists of 2 eggs. Larger sets, up to 4 or 5, are laid by the euphonias and chlorophonias, and by the migratory species of *Piranga* that breed outside the tropics. The eggs are incubated by the female alone; through the day she takes a number of short sessions, usually lasting from 20 to 30 minutes and rarely exceeding an hour, and keeps her nest covered from 60 to 80 per cent of the daytime. Although there is no well authenticated instance of incubation by a male tanager, he is usually attentive to his mate, sometimes bringing her food while she sits, or else, as in *Ramphocelus*, presenting it to the eggs while she is absent, seeming thereby to anticipate the hatching of the nestlings. Recorded incubation periods range from 12 to 14 days, rarely longer.

The nestlings are hatched with tightly closed eyes and sparse, loose down. The interior of the mouth is red. Brooded by the female only, they are fed by both parents; the chief exceptions to this rule are certain nests of the Scarlet-rumped Tanager, in which species females are more numerous than males with the result that some of them form irregular attachments and rear their young without a mate's help. In the Golden-masked Tanager

*Tangara larvata*, young of the first brood, still in immature plumage, may help to feed a later brood of the same season; and in this and several related species (e.g. the Plain-coloured Tanager *T. inornata* and the Speckled Tanager *T. chrysophrys*) 3 or 4 individuals in full adult plumage sometimes attend 1 or 2 nestlings. Food is brought to the nest in the parent's bill or mouth, except in the euphonias and chlorophonias, which regurgitate to the nestlings. Droppings are swallowed or carried off in the bill, and the nest is kept clean. The nestling period varies in an interesting manner, according to the character and site of the nest. It is shortest (10-13 days) in species that build low, open nests, including *Ramphocelus* and *Eucometis*; in the higher, open nests of *Tangara* and *Thraupis* it is longer (14-20 days); and in the covered, often high, nests of *Tanagra* and *Chlorophonia* it is longest (17-24 days). Tanagers scarcely ever give a distraction display when their nest or young are, or appear to be, in danger, but this has been witnessed in the ant-tanagers *Habia* spp. by Willis. Euphonias and chlorophonias may take more than a year to acquire adult plumage and the males sometimes breed in transitional attire.

See also FINCH, PLUSHCAPPED.

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**TANAGER, SWALLOW:** see SWALLOW-TANAGER

**TANAGRINAE:** same as Thraupinae (see TANAGER).

**TAPACULO:** substantive name of some species of Rhinocryptidae (Passeriformes, suborder Tyranni); in the plural, general term for the family. This group of less than 30 species is considered to be related to the antbirds (Formicariidae). They are ground-dwelling birds of South and Central America, from about the size of a wren *Troglodytes* sp. to that of a thrush *Turdus* sp. One of the special morphological characteristics of the tapaculos is a large movable flap (operculum) which covers the nostril completely and gave rise to the name currently used for the family (previously called Pteropochidae). Another structural characteristic is that the back edge of the sternum (metasternum) has 4 notches.



associated with small body size and high metabolic rates during daily activity. Nestlings of the Swift *Apus apus* become torpid when weather conditions are such that their parents cannot obtain the supply of insects necessary for feeding them (Koskimies ; Lack & Lack). They can withstand many days of fasting that would be fatal to the nestlings of most birds, and while they are unfed their body weight falls steadily as first the fat deposits and then the tissues are drawn upon to maintain the basal metabolism ; recovery sometimes occurs when as much as 50 per cent of the weight has been lost. The temperature of the adult Swift is 105–106° F (ca. 41° C) ; that of the feathered young ranges from 99° F to 102° F (37–39° C) but rises to 105° F shortly before they leave the nest. After several days of starvation, the temperature of the unfeathered nestling, however, falls at night nearly to that of the air, sometimes as low as 70° F (21° C), but rises to normal during the day. The nestlings are thus homoeothermic by day but poikilothermic by night.

In the hummingbirds, on the other hand, the incubating bird does not become torpid at night, and it thus maintains the temperature of the eggs or nestlings. The insulation of the nest helps in this, and the young do not become torpid at night before they leave the nest. Pearson points out the considerable saving in calories per 24 hours in a hummingbird if it becomes torpid instead of going to sleep at night, and the comparatively small expenditure of time and energy needed for warming up in the morning. In larger birds the saving in calories is comparatively small, and the time and energy needed for warming up are comparatively much greater.

It is interesting to note that the birds known to become torpid belong to the families Caprimulgidae, Trochilidae, and Apodidae, which on other grounds have long been closely associated systematically.

See also HUMMINGBIRD (second article).

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**TORRESIAN:** see AUSTRALASIAN REGION

**TOTIPALMATE:** having all 4 toes connected by webs (see LEG).

**TOUCAN:** substantive name of species of Ramphastidae (Piciformes, suborder Galbulae) ; in the plural, general term for the family. The name comes from 'tucano' in the language of the Tupi Indians of Brazil. The family consists of 5 genera and about 37 species of middle-sized or large birds (12–24 inches long) confined to the tropical parts of the American continents. Wholly arboreal, they occur only in wooded regions, chiefly at low and middle altitudes. The outstanding feature of these ungraceful birds is the bill, which in all species is enormously enlarged, while in some it exceeds the body in length and almost equals it in bulk ; the nostrils are at the extreme base. Nearly always it is coloured with several bright and contrasting hues. Although in some species it appears almost too heavy for the bird to support, lightness combined with strength is obtained by a network of bony fibres ramifying through the space within the horny outer shell. In size this bill compares with that of the hornbills (Bucerotidae) of the Old World tropics, but it always lacks the dorsal outgrowth or casque of the latter ; the two families are not closely related. The toucan's tongue is also remarkable ; it is a long, narrow, horizontally flattened, thin lamina that may attain a length of 6 inches in the largest species, and its distal part is on both sides obliquely notched by indentations that become progressively deeper toward the apex, where it has a bristly aspect. The wings are short and rounded ; the tail tends to be long ; the legs are strong and the feet zygodactylous.

The largest toucans belong to the genus *Ramphastos*, which includes species up to about 2 feet in length. The Rainbow-billed (or Keel-billed) Toucan *R. sulfuratus* ranges through the forests from southern Mexico to northern South America. As is the case in most toucans, the sexes are alike in coloration, but the males are on the average larger than the



females. About 18–20 inches in length, this stout bird is largely black, slightly glossed with green on the upper parts, and washed with maroon on the hindneck. The upper tail coverts are white. The cheeks, throat, and foreneck are bright yellow, and the under tail coverts are bright poppy-red. The coloration of the great, swollen bill varies considerably with individuals, and, with the exception of violet, all the colours of the rainbow occur. The tints blend rainbow-wise into each other, and the basal margin of the bill is deep black. Other members of this genus have fewer but more strongly contrasting colours on their bills.

The genus *Pteroglossus* consists of long-tailed, middle-sized or small toucans usually called araçaris. The Collared Araçari *P. torquatus* is a slender bird, about 16 inches in length, which is found in wooded country at the lower altitudes from southern Mexico to Colombia and Venezuela. In both sexes, the upper plumage is generally almost black, glossed with green on the back, with a bright red rump and upper tail coverts. The throat and foreneck are black; the more posterior under plumage is largely yellow, with a band of black and red across the upper part of the abdomen. The bill, less vividly coloured than in certain other araçaris, is off-white, grey, and black. The cutting edge of the upper mandible has widely spaced tooth-like projections. The bright yellow eyes are surrounded by red bare skin. In this genus is sometimes placed the curious Curl-crested Toucan *P. beauharnaisii* of the upper Amazon valley; the feathers of its head consist largely of the broadly expanded horny shaft; those on the pileum are curled forward and resemble shavings of glossy black horn.

The toucanets of the genus *Aulacorhynchus* are largely green in plumage and live at higher altitudes than other members of the family, reaching about 10 000 feet in the Andes and in the highlands of Middle America. The Blue-throated Toucanet *A. caeruleogularis*, confined to the mountains of Costa Rica and western Panama, is about 11 inches in length. In both sexes the green plumage which covers most of the body lacks metallic brilliance. The cheeks, chin, and throat are dark blue, and the under tail coverts are chestnut. The bill is yellow, white, red, and black, with yellow predominating. Toucanets perform 'vertical migrations', but other members of the family seem not to migrate.

Toucans are sociable birds, often found in small flocks of a few to more than a dozen individuals, yet they are almost devoid of group impulses. When they travel, one flies away and then another follows, and so they straggle on, one by one, until the whole flock has moved. The larger species fly with

alternate flapping and gliding, tracing an undulatory course; but the flight of some of the smaller kinds is swift and direct. Toucans bathe in the water that collects in hollows in the crotches of trees or in the upper side of horizontal limbs, often high above the ground. They evince curiosity, and in remote forests they may look down with interest at the activities of a botanical collector or other human intruder. They are frolicsome birds, jumping about and sometimes playfully striking their bills together in a sort of fencing, or grasping each other's bills and pushing. Sometimes they preen each other's plumage with the tips of their great bills. In the Rainbow-billed Toucan and the Fiery-billed Araçari *Pteroglossus frantzii*, one individual has been seen to feed another, doubtless its mate.

Toucans eat many berries and other small fruits, and they vary their diet with such insects, spiders, and the like as they can catch, including fluttering termites on evenings when the air is full of the winged sexual brood. Seizing the food in the tip of its great bill, the toucan tosses its head upward to throw the piece back into its throat. Large items are first torn with the bill while held against the perch with a foot. The toucan that Humboldt and Bonpland carried on their historic canoe voyage up the Orinoco liked to fish in the river. Species of *Ramphastos*, *Pteroglossus*, *Aulacorhynchus*, and doubtless other genera, devour the eggs and nestlings of small birds.

It is in connection with the toucans' feeding habits that their peculiar bills must be considered. The long bill enables these heavy, clumsy birds to reach fruits that grow at the slender tips of branches, while they themselves perch farther inward where they find more adequate support. But to give a longer reach, the bill need be neither thick nor brightly coloured. The size and vividness of toucans' bills probably serve them well when they make predatory visits to the nests of other birds; they are so intimidating that even small hawks (Accipitridae) and the boldest of the American flycatchers (Tyrannidae) fear to attack a toucan perching beside their nest. But when the pirates are flying and cannot turn their heads to defend their backs, the outraged parents sometimes buffet them. The vivid bill may also enter into courtship, although little is known about toucans' nuptial displays. It has been suggested that the long bill may also help the incubating or brooding toucan to repel enemies from the doorway of its hole, but most toucans hurry forth from their nests at the first hint of danger.

Toucans are poorly endowed vocally. Their monotonous calls have been compared to the croak-



ing of frogs, the mewing of gulls (Larinae), and the yelping of puppies. Rattling notes are sometimes given. The araçaris utter high, sharp notes, surprisingly weak for such large birds. The 'dios te de, te de, te de' of the Chestnut-mandibled Toucan *Ramphastos swainsonii* is, however, not unmelodious as the birds float down from distant tree-tops; these birds sing much at nightfall.

Araçaris roost throughout the year in the old holes of woodpeckers (Picidae) or other cavities, usually high in trees. Each flock seems to have a number of such lodgings; if their suspicions are aroused as they approach one of these, they may retire into another. Five or 6 adults may sleep in the same hole, folding their tails over their backs to save space in crowded quarters. In captivity, *Ramphastos* spp. roost with the bill laid among the plumage of the back and the tail folded forward over the bill, so that they become featureless balls of feathers; it is not known where they sleep in the wild.

Toucans nest in trees, in hollows resulting from decay or, in the smaller species, in the holes of woodpeckers (Picidae), of which they may dispossess the makers. They may remove rotten wood from a hole or enlarge the doorway if the surrounding wood is soft, but they do no real carving. Toucans' nests are often at a great height, but exceptionally, for lack of a high hole, they choose one near the ground. Each clutch consists of 2-4 white, broadly ovate eggs. The Rainbow-billed Toucan brings a few green leaves into its hole and may carry them away after they wither. Otherwise, toucans take no lining into their nests; but the many large seeds that they regurgitate while they sit soon form a pebbly bed beneath the eggs. Incubation is performed by both parents, who are surprisingly restless for such large birds. They seldom sit for more than an hour at a stretch, and often the eggs are left exposed for from a few minutes to nearly an hour while both attendants go off to forage. Even if, as in the araçaris, both parents had slept in the nest hole before laying began, only one stays with the eggs at night; but it is not known whether this is the male, as in woodpeckers and certain puff-birds (Bucconidae) and cuckoos (Cuculidae), or the female, as in most kinds of birds. At a nest of the Blue-throated Toucanet the incubation period was 16 days, but that of the larger species is unknown.

Toucans are hatched perfectly naked, with no trace of down. Their eyes are tightly closed, and the lower mandible is both longer and broader than the upper one. Their heels are equipped with prominent thickened pads, from which project a

number of strong tubercles, arranged in a peripheral ring in species of *Ramphastos*. These heel-pads, along with the abdomen, bear the nestling's weight; their function appears to be to prevent abrasion of the heel joint by the rough floor of the nest. The nestling's uropygium is extraordinarily long and prominent and is often held with a strong upward tilt. The young toucans develop with extreme slowness; they are 3 weeks old or more before their eyes begin to open, and at this age they are still largely naked.

Both parents brood and feed the nestlings, nourishing them largely with fruits, insects (especially while they are younger), and occasionally a lizard, small snake, or the nestling of some other bird. Much of the food is carried to the nest in the throat or crop, but usually a final item is held prominently in the bill and given to a nestling before the remainder of the load is brought forth. Waste material is removed from the nest in the parent's bill. In the case of the Blue-throated Toucanet, a single parent sleeps with the nestlings until a few days before their departure, but in the araçaris both parents pass the night with them. In Panama, 6 Collared Araçaris roosted in a very high hole that was afterwards used for breeding; only one parent slept in it while incubation was in progress, but after the eggs hatched 5 adults roosted in the nest hole each night; and all 5 of them fed the nestlings, of which there were at least 3. The nestling period of this species is 43-46 days, and that of the Blue-throated Toucanet is 43 days. Fledgling araçaris return to sleep in the nest hole with their parents, but apparently this is not true of toucanets. In the highlands, toucanets rear 2 broods in a season, but the larger toucans of the lowlands apparently attempt to produce only a single brood.

See Plate 32 (colour).

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**TOUCANET:** substantive name of *Aulacorhynchus* spp. (see TOUCAN).

**TOUCH:** a sense of which the characteristics in birds are little known apart from what can be