BEGINNERS' GUIDE

FIELD ORNITHOLOGY

ZOOLOGICAL SURVEY OF INDIA
CALCUTTA

BEGINNERS' GUIDE

FIELD ORNITHOLOGY

J K. JONATHAN
P.P. KULKARNI

ZOOLOGICAL SURVEY OF INDIA
CALCUTTA
1989

Published : January, 1989

Typeset by XEROSTAT, 13-B, Camac Street, Calcutta 700 017
Printed in India at Art Printing House,
43, European Asylum Street, Calcutta 700 019.
Published by the Director, Zoological Survey of India,
Calcutta 700 020

FOREWORD

The Zoological Survey of India is an important institution in the Department of Environment, Forests, and Wildlife, Govt. of India. This Survey has been arranging a number of short-term courses to educate amateur nature lovers and representatives from non-governmental voluntary organizations about Nature and Conservation.

The Training and Extension Division annually undertakes courses on collection, preservation and identification of insects and mites of economic importance; Environment awareness and Wildlife Conservation, Plankton identification and bioenergy assessment and Field Ornithology. All these have received wide appreciation.

On the occasion of the Third Course in Field Ornithology, the Training and Extension Division is bringing out this 'Beginners' Guide to Field Ornithology' which carries preliminary information from the Origin of Birds to their conservation. I hope this book will be a stepping stone towards acquiring basic knowledge about birds in general and their field study in particular.

Zoological Survey of India
Calcutta

Asket Singh
Jt. Director-in-Charge

CONTENTS

Chapter 1

INTRODUCTION

In timeless age, a reptile like bird called *Archaeopteryx*, with its scales modified into feathers, achieved the first true flight. Since then, the air, water and ground are adorned by these beautiful creatures. The birds are distinguished from all other animals by their feathers. And because of their brilliant colours, adaptation to fly, swim and run, they are seen every where. Their peculiar mode of life, nesting and breeding habits have always attracted the attention of man.

The Zoological Survey of India, of late has been periodically holding short term courses in various disciplines of Zoology.This training course in Field Ornithology is aimed at creating an interest in amateur workers and nature lovers in the birds' studies. Nevertheless the purpose of holding it is to provide the trainees with an up-to-date scientific information in Field Ornithology.

The Beginners' Guide to Field Ornithology has been prepared by the Training and Extension Division of the Survey keeping in view the need of the participants to document major aspects about the subject.

A number of topics like Origin of Birds, their Structure, Survival, Adaptation to Flight, Birds as Friends and Foes, Magic of Birdsong, etc., may look beyond the scope of actual Field Ornithological studies, but they have been included in this book to broaden the scope of information on birds.

A good number of books and guides are available on Indian Avifauna. But these books contain voluminous information and the technicality in the descriptions of individual species of birds make the beginners feel that the subject is beyond their scope.

The main purpose of this handbook is to provide the scientific yet interesting information on Field Ornithology, which will motivate the readers to undertake studies on birds with

interest. Careful studies of scientific descriptions of Indian birds available in the works suggested for further reading will help them to identify individual bird species.

We wish to express our gratitude to Dr. B.S. Lamba, the then Joint Director-in-Charge, for providing all the facilities to prepare this guide. We offer special thanks to Dr. A.K. Ghosh, Scientist-SE, for his constant encouragement and keen interest in the preparation of this guide.

We are also thankful to Shri G. Shivagurunathan, Publication Production Officer and to Dr. G.S. Arora, Scientist-SE, for helping us in various ways. The exacting task of typing on the electronic typewriter by Shri Anil Bhattacharya and illustrations by Shri S.K. Chanda are gratefully acknowledged. The articles on Rare and Vanishing Species and Some Interesting Birds have been contributed by Shri J.M. Dasgupta, and Collection and Preservation of Birds, by Dr. J.K. Sen and Shri D.N. Basu.

It is hoped that the readers will enjoy this Beginners' Guide to Field Ornithology.

Chapter 2

ORIGIN : BIRDS ARE GLORIFIED REPTILES

In the eighteenth century Darwin's theory of Organic Evolution brought a new line of thoughts and scientists began to search afresh for the ancestral stocks of all the living organisms. How did the birds originate? and what was their ancestor looking like? The probable answer was, birds originated either from reptiles or they took to the air through a parallel line of evolution directly from life in water.

It was during 1861 that a fossil was discovered in Europe, which gave convincing clues about the ancestors of birds. The fossil was named *Archaeopteryx*. It showed admixture of characters of both the reptiles and the birds. Even the modern birds have still retained reptilian characters : their egg laying habit, scales on their legs strongly support their link with reptiles.

It was, a little more than a century ago man discovered a fossil of a creature which perhaps 100,000,000 years before had died in the muddy bottom of a long vanished sea in Europe which is known as 'Bavaria' This slab of slate which was of great interest to scientists found its way to the British Museum. This strange looking animal-remain was given a name *Archaeopteryx*, which means Primitive Wing, and considered by scientists as one of the oldest birds on earth. The most important feature of this bird-like animal was that it had feathers. In addition, its wings, breast bone, legs and feet were like those of modern birds. However, those who considered it a feathered reptile, it had a long jointed bony tail and short, blunt and rounded head, resembling a lizard's snout than to a bird's beak. Further it had teeth in both the jaws and bones resembling those of reptiles, and had three free fingers on each wing.

If we consider *Archaeopteryx* as an ancestor of birds, we have to speculate changes that *Archaeopteryx* had to undergo to evolve modern birds. In the process of evolution, the structures which are in constant use become stronger and more ef-

ficient, and those which are not in use become weak or degenerate. Similarly as birds developed stronger and more efficient wings they had lesser use for the tail, which degenerated over millions of years to become knob-like. The modern birds have no teeth in their jaws, but teeth were found in certain fossils which every one agrees were of birds (eg. *Hesperornis*). The modern birds still have the thumb separate, but the other finger bones are more or less fused together. A strange bird Hoatzin, found in South America has claws on the thumb and index finger that it used for climbing, just as *Archaeopteryx* might have used its free fingers.

During the course of study more and more fossils of birds were found, many of them have close resemblance with existing birds. One of the emu-like forms, Dormornis, was at least twice as tall as man and almost as large as the Moa of New Zealand, which became extinct so recently (about 300 years ago).

The long extinct *Archaeopteryx* can be seen as a reptile-bird, sharing characters both with reptiles and birds. This suggests that birds and reptiles evolved from a common ancestor. Even the modern birds have reptilian characters; their egg laying habit, presence of scales on their legs, presence of thumb bone, and even claws on thumb and index finger. This suggests that birds at a certain stage evolved from a reptile-like creature.

The admixture of avian characters, on one hand and the reptilian on the other justifies *Archaeopteryx* a connecting-link between the reptiles and birds.

The following evidences favour the reptilian origin of the birds.

Anatomical Evidences

1. Both reptiles and birds have well formed exoskeleton : scales in reptiles and feathers in birds. The hind limbs in most of the birds are covered with scales.
2. Exoskeletal structures including the horny covering of the beak in birds are shed.
3. Both cervical and thoracic ribs are present.

4. The wings of some birds contain one or two digits ending in claws.
5. The gizzard is present in birds and crocodiles.
6. The caecum and cloaca are present in both.
7. Avian heart is 4-chambered. The heart of crocodiles is almost 4-chambered.
8. The kidneys are elongated.
9. Urinary bladder is absent in birds and snakes.
10. Both reptiles and birds are oviparous.
11. The pecten is present in the eye of birds and crocodiles.

Embryological Evidences

1. The sperms are similar in size and eggs are large, albuminous, covered with hard shell, development is by incubation.
2. The segmentation is meroblastic.
3. The development of scales and feathers is similar.
4. The organ of Jacobson is present in the embryonic stage of birds.

Palaeontological Evidences

The palaentological studies of fossil birds and reptiles give strongest support to the reptilian ancestry of birds.

Similarities between fossil birds and modern reptiles: The earliest known fossil birds, such as *Archaeopteryx, Griphosaurus, Hesperornis, Baptornis, Ichthyornis, Apatornis,* etc., show many reptilian features.

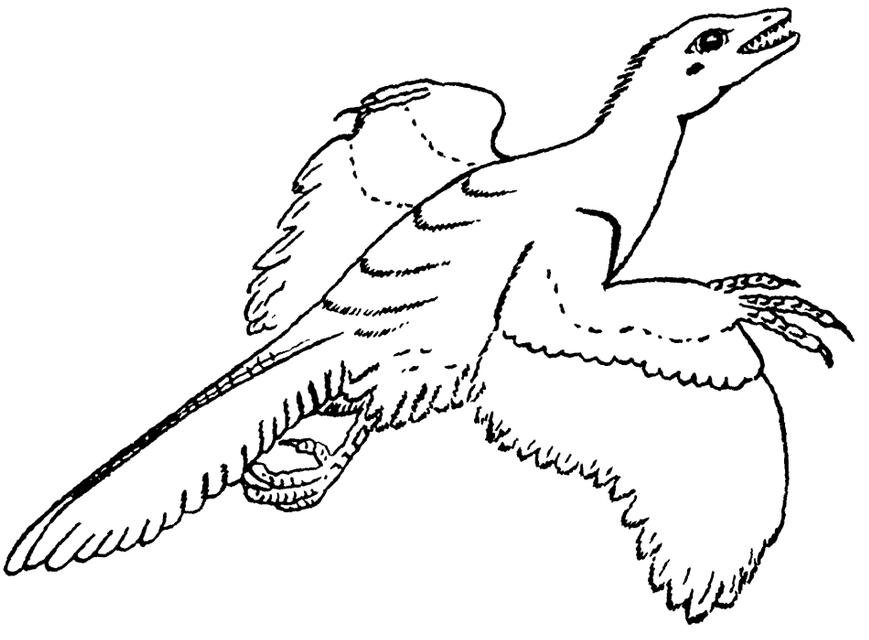
The axis of the body was elongated and lizard-like. The vertebrae had amphicoelous centra. Long tail was present with 18-20 caudal vertebrae. Fore limbs with three-clawed digits. The pectoral girdle had a distinct T-shaped interclavicle and 'V' shaped furcula. Each hind limb had four-clawed digits and the phalangeal formula 2,3,4,5. The shape of the skull was more reptilian. Well developed short and blunt beak with well formed conical teeth lodged in sockets.

Similarities between fossil reptiles and modern birds: Many fossil reptiles were adapted to aerial mode of life and showed many avian features (e.g. *Euparkeria, Dinosaurs, Pterosaurs,* etc.).

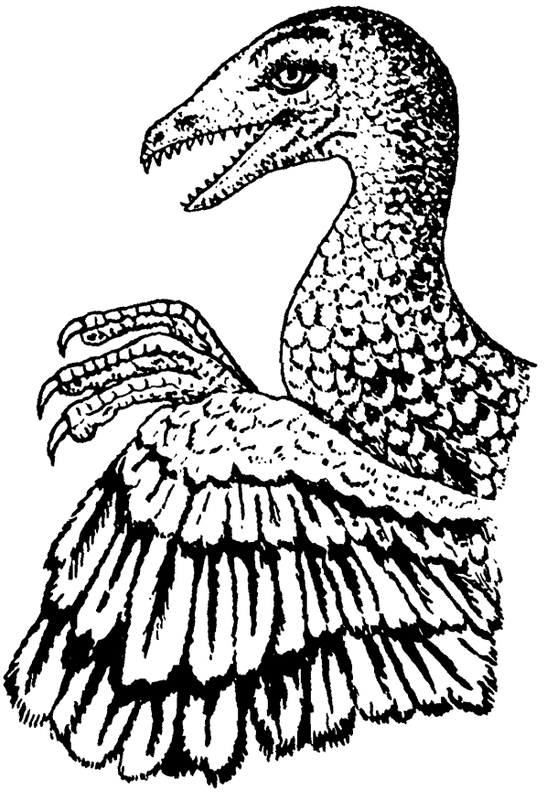
The skull was long and skin suggesting the existence of a beak-like structure. The hind limbs were longer and showed the dawn of bipedal habit, this form of bipedal reptiles gave origin to birds. The ostrich-dinosaur was bipedal reptile and walked on three toes. The digits of the forelimb became reduced to three and were possibly modified for grasping.

The cumulative evidences from all sides added more weight to the idea that reptiles and birds are phylogenetically related with one another.

Figure 1. The fossil of *Archaeopteryx*.



a



b

Figure 2—a, b. *Archaeopteryx* : Somewhere in Timeless Age (an artist's impression)

Chapter 3

THE WORLD OF BIRDS

Birds exhibit a wide range of diversity in their structure. Their shape varies from the small tiny bird about six centimetres in length and weighing just two grams to the largest form, about 2.5 metres high and weighing more than 170 kg. The occurrence of varied combinations of colour patterns and plumage and also feathers may confuse the beginners to classify them into groups convenient for their study. On the contrary, the very fact that the birds exhibit a wide range of charming, attractive colours, their study has keenly been pursued both by amateurs and scientists as well. We know, there are about 1200 different varieties of birds available in our country. Birds have been classified into 27 major groups—the orders. These orders contain smaller units from families to further down to genera and species. The classification of Indian birds is given here to make the readers acquainted with it and to present a panorama of the world of birds. Commonly known birds occurring in each of the families have been illustrated to facilitate the readers to have the idea of the group. Detailed descriptions of some interesting species of birds occurring in India are also appended.

It is thought that there are as many birds in the sky as there are stars in our Galaxy—about 10,000 million. There are perhaps 900 different species of birds existing in this world. As in any other animal group, these birds are further classified for their scientific study into groups of similar birds — the species. All the birds belong to class Aves, which is further divided into two subclasses—Archaeornithes (the old or fossil species of birds) and the Neornithes (the existing birds). Further division of these subclasses forms 30 (according to some experts, 27) orders. Each order is subjected to further division in to families, which contain similar genera made up of birds of related species. The broad outline of classification of birds of India and Pakistan has been given here after S.D. Ripley,

1982. Approximately 1200 species (including subspecies) of birds are known to occur in India.

Classification of Birds

Class **AVES**

Subclass NEORNITHES : Typical Birds

Order **Gaviformes** : Loons
- Family GAVIIDAE : Divers (Gavia), Loons

Order **Podicipediformes** : Grebes
- Family PODICIPEDIDAE : Grebes (Podiceps, Podilymbus)

Order **Procellariiformes** Albatrosses, Shearwaters, Petrels (Diomedea)
- Family PROCELLARIIDAE : Petrels and Shearwaters
- HYDROBATIDAE : Stormy Petrels

Order **Pelecaniformes** Tropic-birds, Pelicans, Frigate Birds, Gannet, Anhinga, Cormorant
- Family PHAETHONTIDAE Tropic-birds
- PELECANIDAE Pelicans
- SULIDAE : Boobies
- PHALACROCORACIDAE : Cormorants and Snake-birds
- FREGATIDAE : Frigate Birds, Man O'War Birds

Order **Ciconiiformes** : Herons, Storks, Egrets
- Family ARDEIDAE : Herons
- CICONIIDAE : Storks
- THRESKIORNITHIDAE : Ibises and Spoonbills
- PHOENICOPTERIDAE : Flamingos

Order **Anseriformes** : Ducks, Geese, Swans
- Family ANATIDAE : Ducks, Geese, Swans

Order **Falconiformes** : Vultures, Hawks, Falcons, Kites
- Family ACCIPITRIDAE : Hawks, Vultures, Kites
- FALCONIDAE : Falcons.

Order **Galliformes** : Megapodes, Pheasants
- Family MEGAPODIIDAE : Megapodes (Leipoa)
- PHASIANIDAE : Pheasants, Quails, Fowls

Order **Gruiformes**: Cranes, Rails, allies
Family TURNICIDAE: Bustard-Quail
GRUIDAE: Cranes
RALLIDAE: Rails, Coots
HELIORNITHIDAE: Finfoots
OTIDIDAE: Bustards.

Order **Charadriformes**: Shorebirds, Gulls, Coursers, Lapwings, Stilts
Family JACANIDAE: Jacanas
HAEMATOPODIDAE: Oystercatchers
ROSTRATULIDAE: Painted Snipe
RECURVIROSTRIDAE: Stilts, Avocets
IBIDORHYNCHIDAE Ibisbill
DROMADIDAE Crab Plover
BURHINIDAE: Stone Curlews, Thick-knees
GLAREOLIDAE: Coursers, Pratincoles
CHARADRIIDAE: Plovers, Sandpipers, Snipes
Subfamily *Charadriinae*: Plovers
Scolopacinae: Curlews, Sandpipers, Snipe Woodcocks
Phalaropinae: Phalaropes
Stercorariidae: Skuas
Laridae: Gulls, Terns

Order **Columbiformes**: Sandgrouse, Pigeons, Doves
Family PTEROCLIDIDAE: Sandgrouses
COLUMBIDAE Pigeons, Doves

Order **Psittaciformes**: Parakeets and Lorikeets
Family PSITTACIDAe Parakeet and Lorikeets

Order **Cuculiformes**: Cuckoos, Koel
Family CUCULIDAE: Cuckoos, Koel

Order **Strigiformes**: Owls
Family STRIGIDAE: Owls
Subfamily *Tytoninae*: Barn Owls
Striginae Owls

Order **Caprimulgiformes**: Frogmouths, Nightjars
Family PODARGIDAE: Frogmouths
CAPRIMULGIDAE: Nightjars

Order **Apodiformes** : Swifts
Family APODIDAE : Swifts
Subfamily *Apodinae* : Swifts
Hemiprocninae : Crested Swifts

Order **Trogoniformes** : Trogons
Family TROGONIDAE : Trogons

Order **Coraciiformes** Kingfishers, Bee-eaters, Rollers and allies
Family ALCEDINIDAE : Kingfishers
MEROPIDAE : Bee-eaters
CORACIIDAE : Rollers, Bluejays, or Dollar Birds
UPUPIDAE : Hoopoes
BUCEROTIDAE : Hornbills

Order **Piciformes** : Barbets, Woodpeckers
Family CAPITONIDAE : Barbets
INDICATORIDAE : Honeyguides
PICIDAE : Woodpeckers

Order **Passeriformes** : Perching Birds
Family EURYLAIMIDAE : Broadbills
PITTIDAE : Pittas
ALAUDIDAE : Larks
HIRUNDINIDAE : Swallows
LANIIDAE : Shrikes
ORIOLIDAE : Orioles
DICRURIDAE Drongos
ARTAMIDAE : Wood Swallows or Swallow-Shrikes
STURNIDAE : Starlings and Mynas
CORVIDAE : Crows, Magpies, Jays
BOMBYCILLIDAE : Waxwings
Subfamily *Bombycillinae* : Waxwings
Hypocoliinae : Hypocolius
Family CAMPEPHAGIDAE : Cuckoo-shrikes and Minivets
IRENIDAE : Fairy Bluebirds, Ioras
PYCNONOTIDAE : Bulbuls
MUSCICAPIDAE : Babblers, Flycatchers, Warblers, Thrushes

Subfamily *Timaliinae*: Babblers
Muscicapinae: Flycatchers
Rhipidurinae: Fantail Flycatchers
Monarchinae: Monarch Flycatchers
Pachycephalinae: Thickheads, or Shrikebilled Flycatchers
Sylviinae: Warblers
Turdinae: Thrushes and Chats

Family TROGLODYTIDAE: Wrens
CINCLIDAE: Dippers
PRUNELLIDAE: Accentors
PARIDAE: Tits
Subfamily *Parinae*: True Tits
Aegithalinae: Longtailed Titmice

Family SITTIDAE: Nuthatches & Wall Creepers
Subfamily *Sittinae*: Nuthatches
Tichodromadinae: Wall Creeper
Salpornitinae: Spotted Creeper

Family CERTHIIDAE: Tree Creepers
MOTACILLIDAE: Pipits and Wagtails
DICAEIDAE: Flowerpeckers
NECTARINIIDAE: Sunbirds
ZOSTEROPIDAE: White-eyes
PLOCEIDAE: Weaver Birds
Subfamily *Passerinae*: House & Rock Sparrows
Ploceinae: Weaver Birds, Bayas
Estrildinae: Waxbills, Avadavats

Family FRINGILLIDAE: Finches
Subfamily *Fringillinae*: Chaffinches
Carduelinae: Goldfinches and allies

Family EMBERIZIDAE: Buntings.

SOME INTERESTING BIRDS

From time immemorial birds have been considered the loveliest and the most attractive creation of God. The popularity of birds probably surpasses that of all other classes of animals because of the striking beauty of their shape and plumage, the grace of flight and their sweet and melodious songs.

For all these reasons the study of birds has been keenly pursued; as such they are better known today than any other group of animals.

India is a vast country which has a diverse topography, viz., sea-coast, estuarine, swamps, lowland marshes, riverine plains and arid tracts with an arm of desert extending from West Asia, plateau hills and towering snowcapped mountains.

Different types of climatic conditions, therefore, exist to support typical flora and fauna in such ecological zonations or regions. Each of these regions has a bird life of its own, which differs in many respects from that of any other area.

About 1200 subspecies are known from India of which 850 are resident, 176 endemic and only 350 are migrants.

Complete detailed descriptions are impossible in the limited space available here. Only some common birds are described here for ready reference.

Spottedbilled or Grey Pelican. *Pelecanus philippensis* Gmelin

It is a long necked, long winged, short legged water bird, commonly known as **Hawasil**. It is a large greyish-white Pelican with brownish-black primaries; bill pale yellowish spotted with bluish-grey on each side of upper mandible, and is of the size of a large domestic goose. The bird is characterized by having a large beak with an elastic skin pouch which act as a net for capturing fish. It is found singly or in small parties, but also often in large flocks. It is a clumsy walker on land but in water it swims well. The food consists of fish. The way in which the bird feeds, is most interesting. A group of birds forms a line and swim with their mouths open, driving the fish into a corner by beating wings on water, often forming a circle and thus giving less room for the fish to escape. The nest is made of sticks on lofty branches of trees growing in swamps. Usually several nests are grouped within a few metres, and in more or less close proximity with the nests of various other water birds—storks, herons, etc. The most striking point about the bird is its usual silence. It is found throughout the watered

tracts of India, Sri Lanka, Burma and the whole of the Oriental Region.

Openbill Stork. *Anastomus oscitans* (Boddaert)

The Openbill Stork is identified at once by its peculiar beak of which the mandibles do not meet properly, leaving a gap between them which is visible even in flight. It is white in colour with the tail and wings black. It is locally known as **Gungla** or **Samukkhol** and is about the size of the Spoonbill. The Openbill Stork is most widely distributed of all storks of India, found in the vicinity of rivers, lakes and marshes in large flocks. Its favourite food items are water snails and mussels. From these it extracts the flesh by mechanical manoeuvering of its beak. Besides molluscs, it consumes crabs, fish and other small animals. It is colonial in breeding habits, and about 400 pairs or more have been found in a single colony. It builds its nests of sticks and twigs on the top of low trees in swamps or flooded jungles. Both sexes take part in all the domestic work. It is widely distributed throughout the Indian Subcontinent.

Spoonbill. *Platalea leucorodia* Linnaeus

The spoonbill is a snow-white marsh bird with a large peculiar spoon-shaped black bill for catching the prey. It is of the size of the Large Egret and is commonly known as **Chamcha**. A crest of pointed and drooping plumes is assumed in the breeding season, which are lost in non-breeding season. The legs are long and black.

This handsome but quaint-looking bird is found in flocks which rest by day on open jheels, the shores of tidal creeks, and the sand-banks of rivers. During the sunset the flock wakes up and flies towards their favourite feeding ground in a marsh.

The food consists of vegetable substances, but all sorts of aquatic insects and their larvae, frogs, small fishes are also consumed. The feeding technique is interesting: the bird wades into the water of jheels and passing its slightly open bill in water, sways with a semicircular motion from side to side. In this process whatever aquatic small animals pass between

the tips, it seizes to swallow. The spoonbill nests in colonies, usually in association with other large waders.The nest is made of sticks, on low branches of trees growing in water. It is a silent bird its only note, a low grunt which it utters when it is in the nest. It ranges throughout South Europe, Africa and East Asia.

Flamingo. *Phoenicopterus roseus* Pallas

It is a beautiful white and pink coloured bird usually found in flocks wandering in shallow jheels. Its body is of the size of the Painted Stork but it is much taller, because of its long legs and neck. Its plumage is white with the rosy-pink flush and the black flight feathers

It is found in flocks, and is shy and wary, avoiding cover, and prefers salty water to fresh. It lives on crustaceans, molluscs and tender vegetables which are collected by a large downcurved pinkish beak modified for this purpose. The mandibles are curved, forming a box like structure with serrated margins. During rest it usually remains standing on one leg and the head is kept tucked under the feathers of the posterior part of the body. The pink coloured neck is excessively elongated which is highly mobile and coiled. It is well known for its peculiar nesting habit. It nests in large colonies, in shallow, vast areas of muddy brackish water. The nest is a mound made by scooping mud with its bill. The nest is about .254 metres, on the top of which a slight depression is made. In this depression eggs are laid. Both sexes take part in incubation. Chicks are fed by the parents. It is widely distributed from Iberian Peninsula and the Cape Verde Islands in the east through parts of Africa to west Siberia and south to Sri Lanka. It is mostly found in western India but spread all parts of India during non-breeding period (rare in Bengal and Assam).

Whitebacked Vulture. *Gyps bengalensis* (Gmelin)

The Whitebacked vulture has an ugly and repulsive appearance with enormous wings and short tail. It is popularly known as the **Gidh**.

Its dark brown plumage with a large white rump associated with naked head and neck distinguishes it from any other vulture. It lives either singly or in groups in large trees on the outskirts of villages and towns. Generally it spends the time circling high in the sky to spot out carcass. It never predates prey but feeds on carrion. This scavenging habit is beneficial to man. During breeding season, nest is built in a tall tree with sticks which may be used year after year. Both the sexes take part in building the nest. The nestling is fed by the parents for many weeks before it is able to fly. It is commonly found in all parts of India, Malaysia and Indochinese subregions.

Indian Peafowl. *Pavo cristatus* Linnaeus

The Indian Peafowl is characterized by its decorative blue-green, purple and bronze plumage all over, accompanied with long upper tail coverts that form a long train falling over the wedge-shaped tail and a peculiar fan shaped crest; female is all brown and without a train. It is of the size of the domestic turkey, and commonly known as the **Mayura** or **More**. *Pavo Cristatus* has been given the status of our National Bird. It avoids dense forest but delights in a mixture of jungle with open country but has adapted to arid and semi-arid areas wherever it has been protected. It is a very wary bird, endowed with a keen sight and hearing, usually runs for cover at the least suspicion of danger. The peafowl is a great walker, it wanders over a large area in pairs or in small parties in the course of a day. The food of the peafowl consists of a variety of vegetables and animal substances—grains, leaves of certain plants, small reptiles, etc. The principal feeding time are in the early morning and for an hour or so before the sunset; during these periods, the bird leaves the shelter and visits open fields. After feeding it repairs to a stream to drink. After the sunset it roost in some tall trees. The cock keeps a harem, his harem consisting of two to five hens and he takes no share in family duties. In courtship display, the cock erects the train vertically and spreads it into a great semicircular fan, the wings are dropped and constantly waggled behind the train, and frequent gusts of vibration cause the many-eyed and multi-hued

apparition to shimmer and scintillate in delightful fashion. It is distributed in India and Sri Lanka.

Spotted Owlet. *Athene brama* (Temminck)

The Spotted Owlet, a nocturnal bird, is most familiar in the countryside and is known as **Ulloo**. It is more or less of the size of the common myna. The hooked bill and the strong claws characterize the bird as a predator. The body is covered with earthy brown coloured plumage, profusely spotted with white above and legs are feathered to the toes. The head is large and spherical with forwardly directed yellow eyes. It can help sighting by rotating the head through 180° During hunting it depends more on its auditory function than vision. It spends the day time hiding in leafy branches or in tree holes and becomes active during night. Its noiseless flight assists in nocturnal activities of predation. It lives mainly on insects, lizards, small birds and small rodents. Food is swallowed whole, the indigestible portion such as skeleton and fur, are ejected in the form of pallets from the mouth. By nature it is noisy and produces chattering notes specially heard during dusk. Generally it prefers to live in plains and foothills around human habitation. It is distributed throughout the Indian subcontinent and Indochinese subregions.

Malabar Pied Hornbill. *Anthracoceros coronatus* (Boddaert)

It is a popular hornbill known as **Dhanesh**, of the size between the Kite and the Vulture. It is a heavy-billed arboreal bird with a prominent casque and with black and white plumage. Its wings are broad, short and rounded, tipped with white, tail long and graduated, outer tail feathers are all white. It is basically a fruit eater and is found in fruit-laden trees. The tail hangs straight down when the bird rests on the branch of a tree. It is known for its curious nesting habit, The nest is made in the hollow cavity of a tree. During the incubation period, the female is plastered, inside the nest cavity with her own droppings, leaving a narrow slit through which the male feeds her. After the chicks are half-grown, she breaks open the

nest entrance and shares with the male in feeding the chicks till they are fully fledged. It has a wide distributional range from India through Indo-chinese and Malaysian subregions to southern China.

Indian Baya. *Ploceus philippinus* (Linnaeus)

The common Indian Weaver bird is popularly known as the **Baya**, resembles the house sparrow but it is slightly larger in size. In breeding season its crown and breast turns bright golden-yellow, face, chin and throat become blackish and the rest of the upper parts streaked with brown and yellow; non-breeding male and female resemble very much the house sparrow, distinguishable from the latter by having stouter and larger bills. It lives in flocks, avoids heavy forests. It is really a bird of open cultivation where babul (*Acacia*) trees and palms are scattered all over. It feeds on seeds of various kinds and does a great deal of damage to standing cereal crops. Indian Baya is well known for is woven bottle shaped nest. The nests are pendulous, long, graceful structures of woven grass, more or less retort shaped — consisting of 3 parts; the uppermost, which is attached to an outer branch of a tree, is a narrow stalk, this widens into a large bulge which contains the nest chamber; and the lowest portion is a long cylindrical sleeve, which opens at the bottom. These nests hang in groups sometimes found in dozen or more. The male is polygamous and he alone does the nest building. Each male usually builds several nests in the same colony, occupied by separate females. Incubation is carried on by the female, and she is responsible for rearing and nursing of the young. It ranges throughout the Indian subcontinent and the Indochinese subregion.

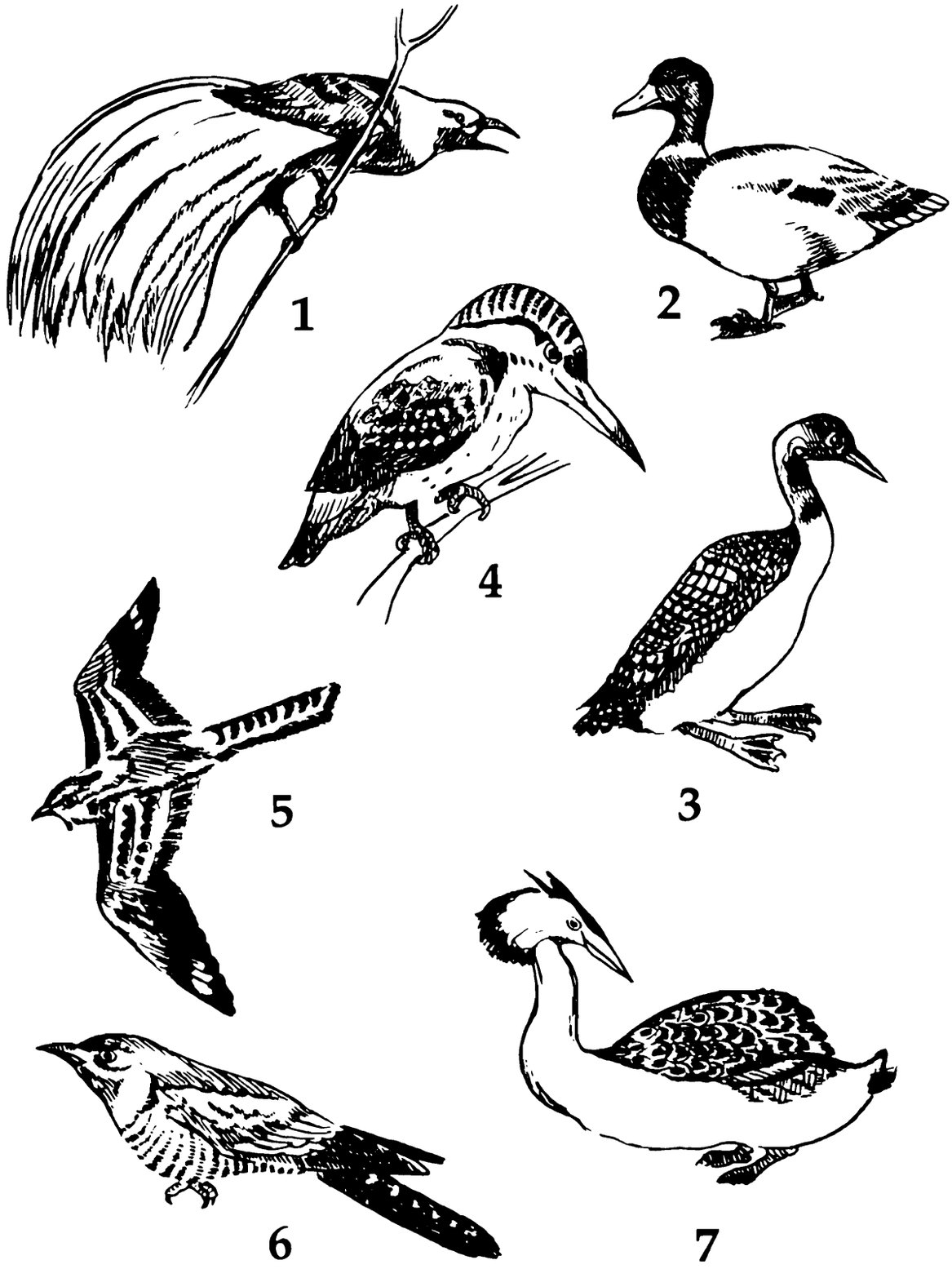
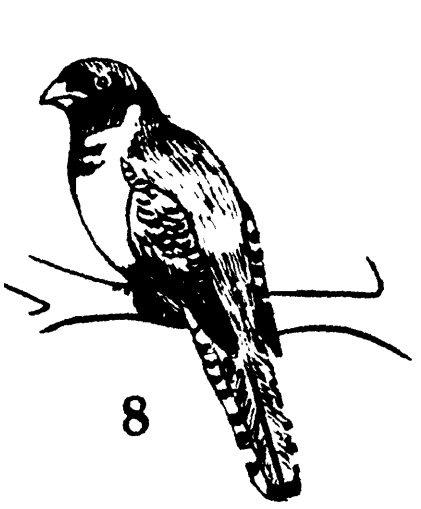
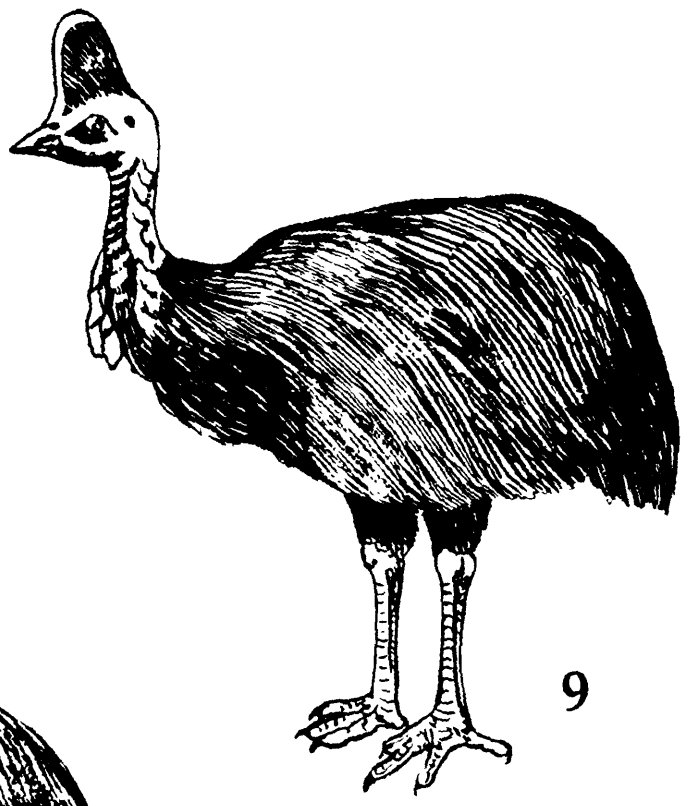
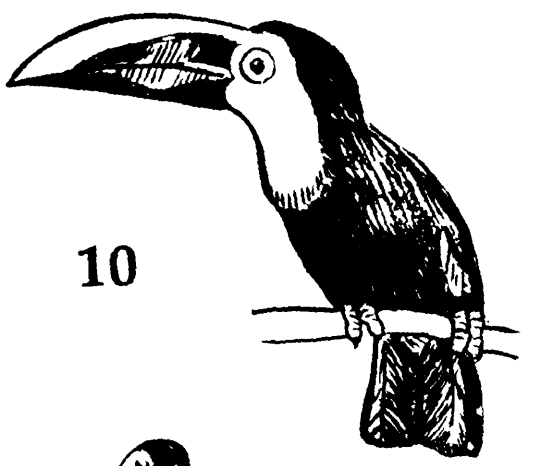
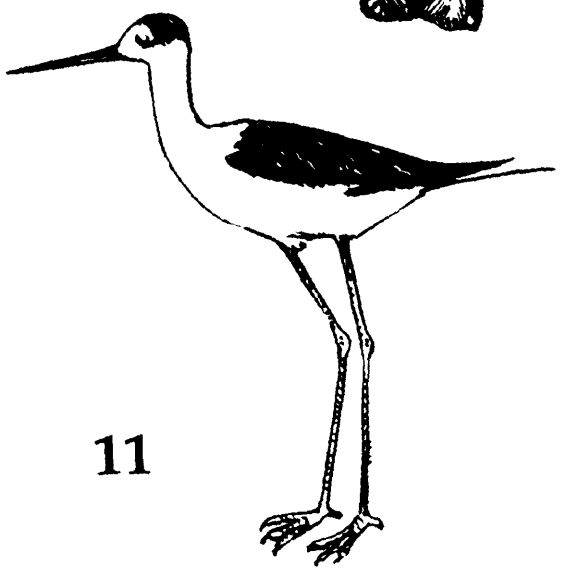


PLATE I.1 — Bird of Paradise (Passeriformes);
2 — Duck (Anseriformes); 3 —Nightjar (Caprimulgiformes);
4 — Kingfisher (Coraciiformes); 5 — Diver (Gaviiformes);
6 — Cuckoo (Cuculiformes); 7 — Grebe (Podicipediformes).









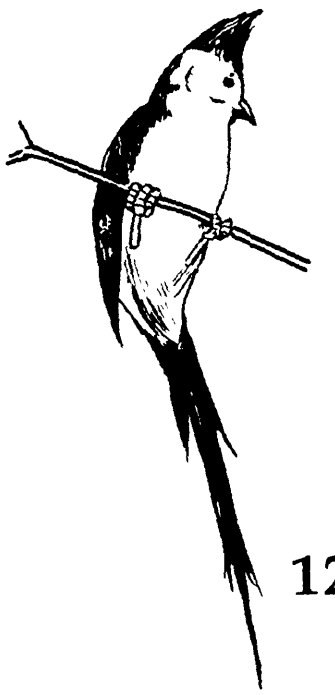


PLATE II. **8** — Trogon (Trogoniformes); **9** — Cassowary (Casuariformes), **10** —Toucan (Piciformes) **11** — Stilt (Charadriiformes), **12** — Mousebird (Coliiformes).

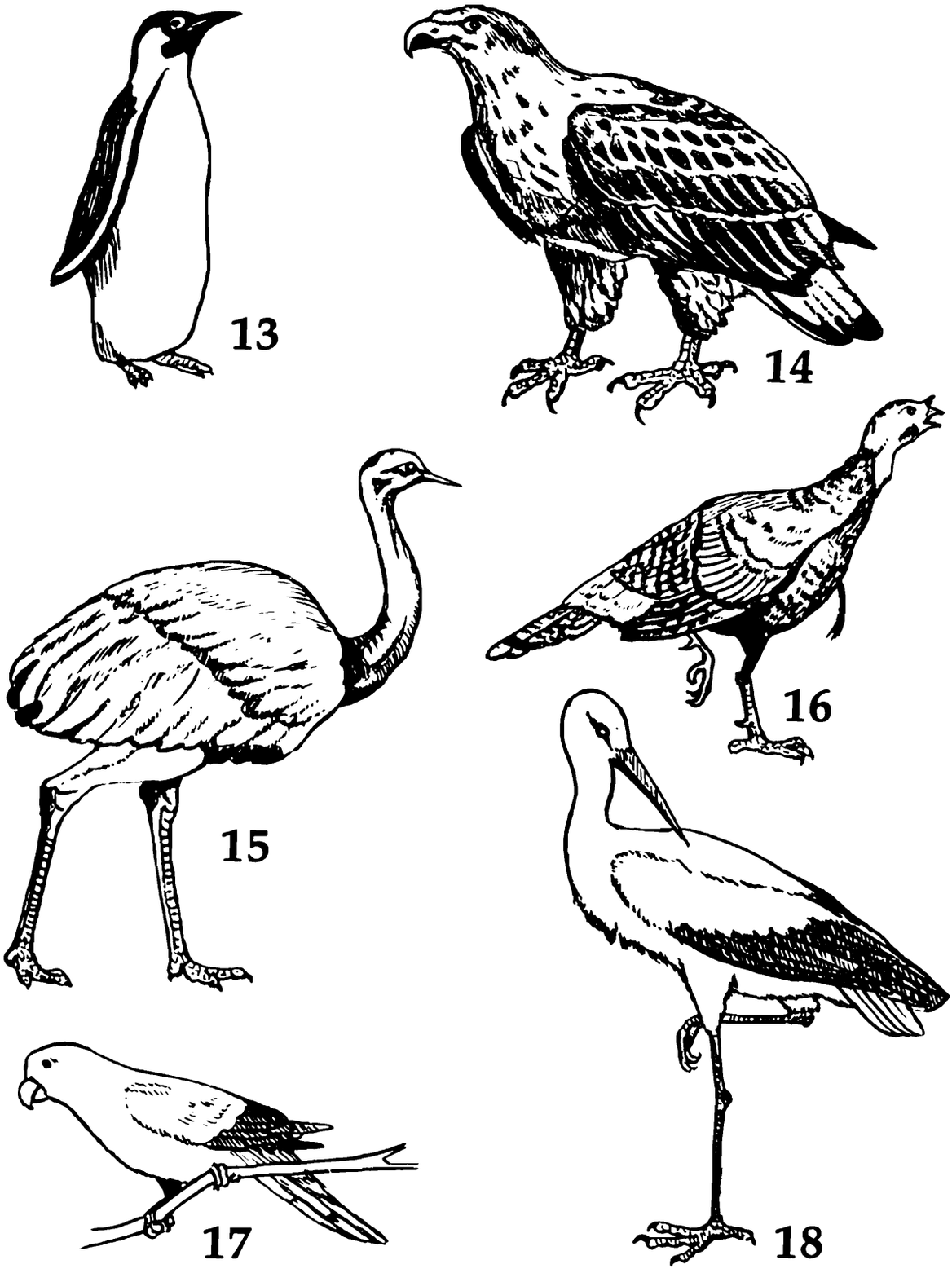
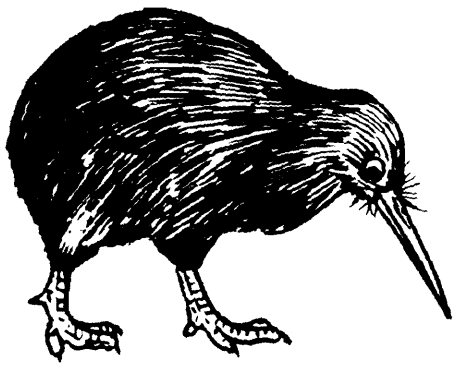
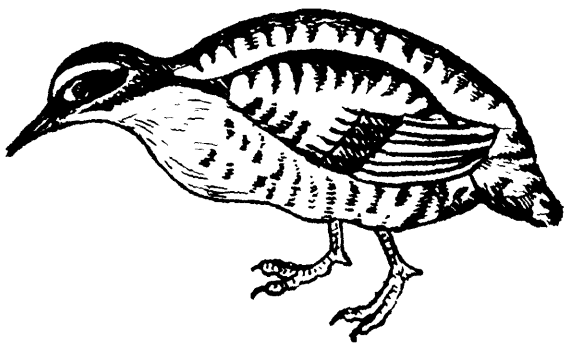


PLATE III. 13 — Penguin (Sphenisciformes); 14 — Eagle (Falconiformes), 15 — Rhea (Rheiformes); 16 — Turkey (Galliformes), 17 — Parrot (Psittaciformes) 18 — Stork (Ciconiformes).

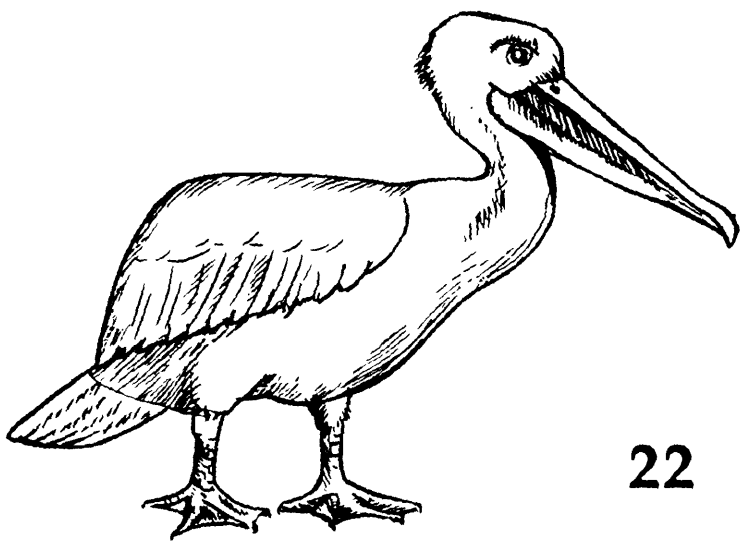


19



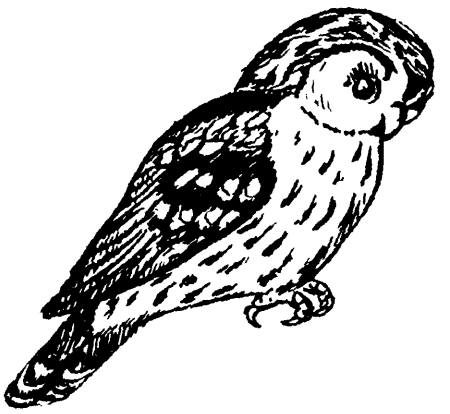
20

21



22

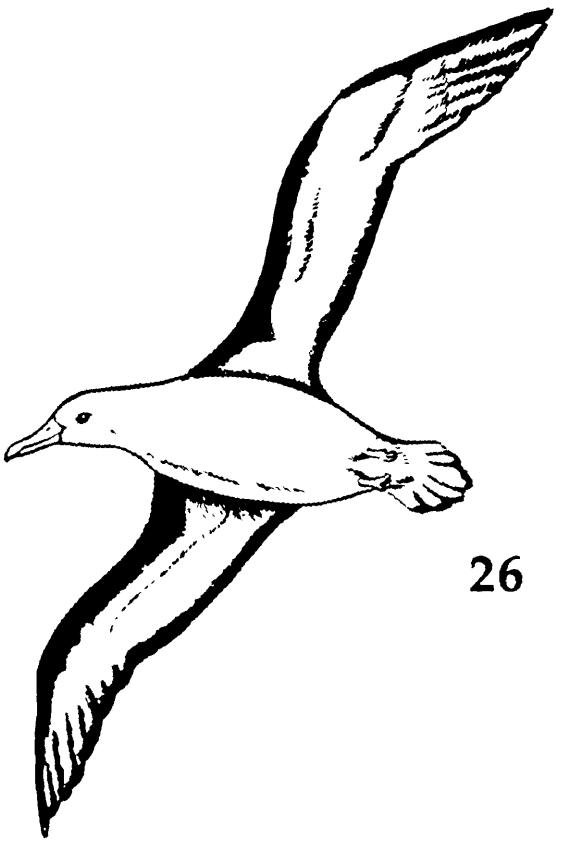
23



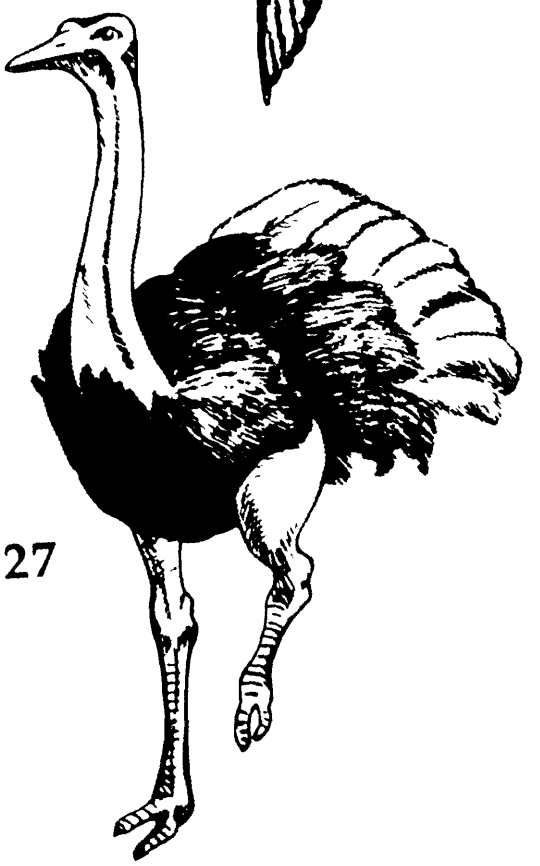
24

PLATE IV. **19** — Kiwi (Apterygiformes); **20** — Tinamou (Tinamiformes); **21** — Hummingbird (Apodiformes); **22** — Pelican (Pelicaniformes); **23** — Pigeon (Columbiformes), **24** — Owl (Strigiformes).

25



26



27

PLATE V. **25** —Crane (Gruiformes) ; **26** — Albatross (Procellariiformes) ; **27** — Ostrich (Struthioniformes).

Chapter 4

BIRDS : THEIR STRUCTURE

The birds are considered to be the most adapted animals in this kingdom. They are found from north to south poles, in water, in desert, in forest and everywhere, because their body is modified in such a way that they can live in almost any environment.

To understand nature of their adaptability, it is essential to know about their general morphology and the modifications which their body organs have under gone to suit their varied surroundings.

As a general rule the body of a bird is clothed with feathers. Feathers growing on different parts of the body are not all alike in structure. The beak, legs, claws, wings and tail vary considerably in different birds and are discussed in detail.

EXTERNAL FEATURES

The body of a bird is distinctly divisible into three regions—head, neck and trunk. The mouth is a wide gap at the anterior end of head and bounded by upper and lower jaws, which are covered with a horny sheath. The eyes are usually located on either side of the head, provided with upper and lower eyelids and nictitating membrane. The external ears are located slightly posterior to the eyes, each aperture is covered with auricular feathers. The neck is long and flexible. Its flexible nature is responsible for the universal movement of the head.

The trunk is compact, stout and immovable and all the vital organs are placed inside there. The trunk has (i) Forelimbs which are modified as wings. Wings are further divided into upper arm, forearm and hand. (ii) Hindlimbs work as legs and carry the entire weight of the body while walking or perching. Legs are usually provided with four toes, of which the first one called hallux, is usually directed backward and the re-

maining three directed forward. The lower part of the hind-limb is usually covered with scales, and toes are provided with sharp claws. (iii) Tail : the posterior conical end of the trunk is known as uropygium, on its ventral side is present the cloacal aperture. The oil gland is present here dorsally, its oil is sprayed all over the body to 'dress' the feathers. Tail is used as steering and brake during flight and as balancing organ during walking, perching and flying.

SKELETON

EXOSKELETON

The following structures form the exoskeleton in birds : Beaks are horny exoskeleton derivatives which cover the upper and lower jaws. Claws are pointed, sharp and horny. These are present at the tip of the toes. Scales are present on the hind limbs. Feathers are supposed to be modified reptilian scales. They are flexible, light in weight and protect the body.

The birds are essentially similar in structure, but the very striking variations in beaks, wings, legs and tails are largely due to their habit and habitats (or the ways in which they make a living). Even taxonomically unrelated birds, if they happen to live in similar localities and catch the same sort of food, tend to grow alike structures—an instance of convergent or parallel evolution. It also happens that closely related birds living in different types of environment, feeding on different food, gradually change in their appearance—a sort of divergent evolution.

Beaks :

The birds that live in different kinds of habitats have different kind of beaks or bills, depending on the food available to them. In the survival of a bird the kind of beak that it has is very important.

The beak, bony structure covered by a horny sheath has two sections, the upper and lower mandibles. Generally the upper mandible is a little longer than the lower, but sometimes it is much longer as in hooked beaks of the Eagle, where as, in some birds the lower mandible is much longer. In cross bills the tips of the mandibles are not in line as in other birds, but

passing along side one another. This adaptation gives them greater leverage when feeding upon pine cones to get at the seeds, on which they feed. When the mandibles are slightly opened the tips can be made to meet.

The birds that eat seeds have small beaks to enable them to pick up the seeds. The birds that live on bigger seeds have strong and stout beaks to crack them open. The birds that feed on fruits and flowers have (e.g. Hornbill) huge bills so that they can push through the leaves to get at the hanging fruits. Humming bird hovers in front of flower and insert its long thin beak to feed on nectar. The birds which eat insects have bills that open wide to capture them. Wood peckers drill into the bark with their chisel-like beaks to find insects. Some birds hunt small birds, reptiles and mammals. The birds of prey (e.g. Hawk, Eagle) have hooked beaks that enable them to tear their victims. Fish-eaters have sawtooth-edge-beaks to have a firm grip on the fish they catch. The bag-like beak of pelican can scoop up fish and the darter can spear its victim with its long sharp bill. The strongest of the bill is owned by the flamingo. It lowers its huge beak upside-down into the water with its long neck and strain tiny animals and plants through comb-like structure in its bill.

Legs :

The birds use their legs to hop, walk over the ground or perch on branches. Bird's feet also display as much variations as their beaks, and again the differences are related to adaptations and varying mode of life.

Typically there are four toes present, three forward and one backward, but the hind toe is lost in many species, mostly the ground dwellers (e.g., Emu, Painted-quail, Stilt, etc.). The Swift, which spends almost all its time in the air can hardly walk at all. Its all four toes are directed forward and it can only use its feet for clinging. The perching birds have three toes pointing forward and one backward. Wood peckers spend most of their time in perching, so they have two toes pointing forward and two pointing backward.

The Ostrich is the only bird with two toes, like the hoof of an antelope, so that it can run very fast. Usually the toes are

free from one another, but their bases are connected by small webs. The web is much larger in some swimming birds like the Ducks, Gulls, etc. The web reaches greatest development when it includes the hind as well as the three toes in front (e.g., Cormorants). Some birds like Coots and Grebes have flaps or lobes of skin along the toes instead of connecting webs. The flaps open as the feet are pushed back through water, and when the feet are pulled forward, the flaps close. This greatly helps them to swim fast. The lotus-birds and Swamp-hens have developed very long, web-free toes which help them to swim and to walk across mud and floating plants. In Kingfishers the third and fourth toes are partly joined. The toes end in claws which vary from the sharp and powerful hooked talons of the birds of prey, to the blunt, almost straight scratchers of the fowl.

Wings :

For an organism which is heavier than air, to fly, it must have prerequisites without which flying is impossible : they must have special organs for flight; light but rigid body, extra energy with provision for high power; speed and with balancing and control mechanisms.

The modern birds with a few exceptions, have evolved these prerequisites. The forelimbs have transformed into wings. The wings are the sole organ of flight. Wings have complicated frame-work of bones, muscles, blood vessels, feathers, etc. The humerus is a strong long bone with a prominent ridge for the insertion of the flight muscles ; radius, ulna and digits form the skeleton of the wings.

During rest, the wings remain folded along the sides of the body. During flight the wings are expanded.

The area of wing is increased by the development of feathers. The action of the wings is controlled by the flight muscles. The important flight muscles are *Pectoralis major*—the down stroke muscle, *Pectoralis minor*— the elevating muscle, *Coracobrachialis*—the depressor muscle and *Tensores patagialis* muscle help keep the patagia tensely stretched when the wings are extended.

ENDOSKELETON

The entire endoskeleton is grouped into (i) Axial and (ii) Apendicular skeletons. Axial skeleton includes the skull, vertebral column and sternum.

The skull is very light and strong. In their search for lightness birds discarded heavy teeth, replacing them with horny beak. Various skull bones are similar to those found in lizards. In birds and lizard it rests on one condyle of the first vertebra and not on two condyles as in most other animals. This helps birds to turn their head freely. The birds can look behind without moving their body.

Vertebrae in the neck of a bird meet at curved surfaces and form ball and socket' joints where as our vertebrae meet each other with flat surfaces. This enables bird's neck to be more flexible than ours. Most mammals have only seven vertebrae in neck, but all birds have more up to twenty-five vertebrae. The rest of the vertebrae have become fused into a solid structure to give a strong support to legs and wings. Birds have few (usually five) ribs joining spine and sternum, which support the bony prothorax. The 'wish-bone'—the furcula is merely the bird's collar bones joined at the front, and that it acts as a brace, keeping the shoulders apart when the wings are raised. It is further supported by another bone, the coracoid, which acts as a strut between the sternum and the wing-joint. The sternum is extremely modified due to the flying habit. It is modified into a boat-shaped structure called keel.

Forelimbs are modified as wings and the hind limbs as legs. The bony components of the forelimbs are greatly altered due to their transformation into wings. The hindlimbs have retained the typical reptilian plan. The pectoral girdle is built up for the attachment of wings. The pelvic girdle holds the hindlimbs to support the body during walking and standing.

ADAPTATIONS FOR FLIGHT

The skeleton of the birds has attained mechanical perfection to have maximum strength. The bones are rod-like or T-shaped. Bones are stout and pneumatic. The development of air-sacs makes the body light. The vertebral column shows the

tendency of fusion—the Synsacrum and pygostyle are typical examples of such fusion of posterior vertebrae. To further minimize the body weight the gall bladder, urinary bladder, right ovary and right oviduct (in female) are absent.

The extra energy and sustained power is obtained through rapid and complete combustion of fuel. This is due to perfect exchange of gases and presence of air sacs. The higher body temperature and non-conducting coat of feather prevent loss of surface heat. A very powerful heart with efficient circulatory system serves as power station.

For an efficient aerial mode of life balancing and steering device is necessary, to achieve this the air-sacs are so arranged on the two sides of the body that a proper centre of gravity is easily restored by shifting the contained air from one side of the body to the other.

There are birds that live on land like Emu and Ostrich which can not fly. They escape danger by running using their long and powerful legs. Penguins also can not fly in air, but they 'fly under water' They can swim at a speed of 36 kilometers an hour with the help of paddle-like wings, which is faster than some birds that can fly in the air.

The tail is provided with rectrices and thought to be a steering organ or rudder, but it acts more like a brake. In addition it helps to maintain their balance.

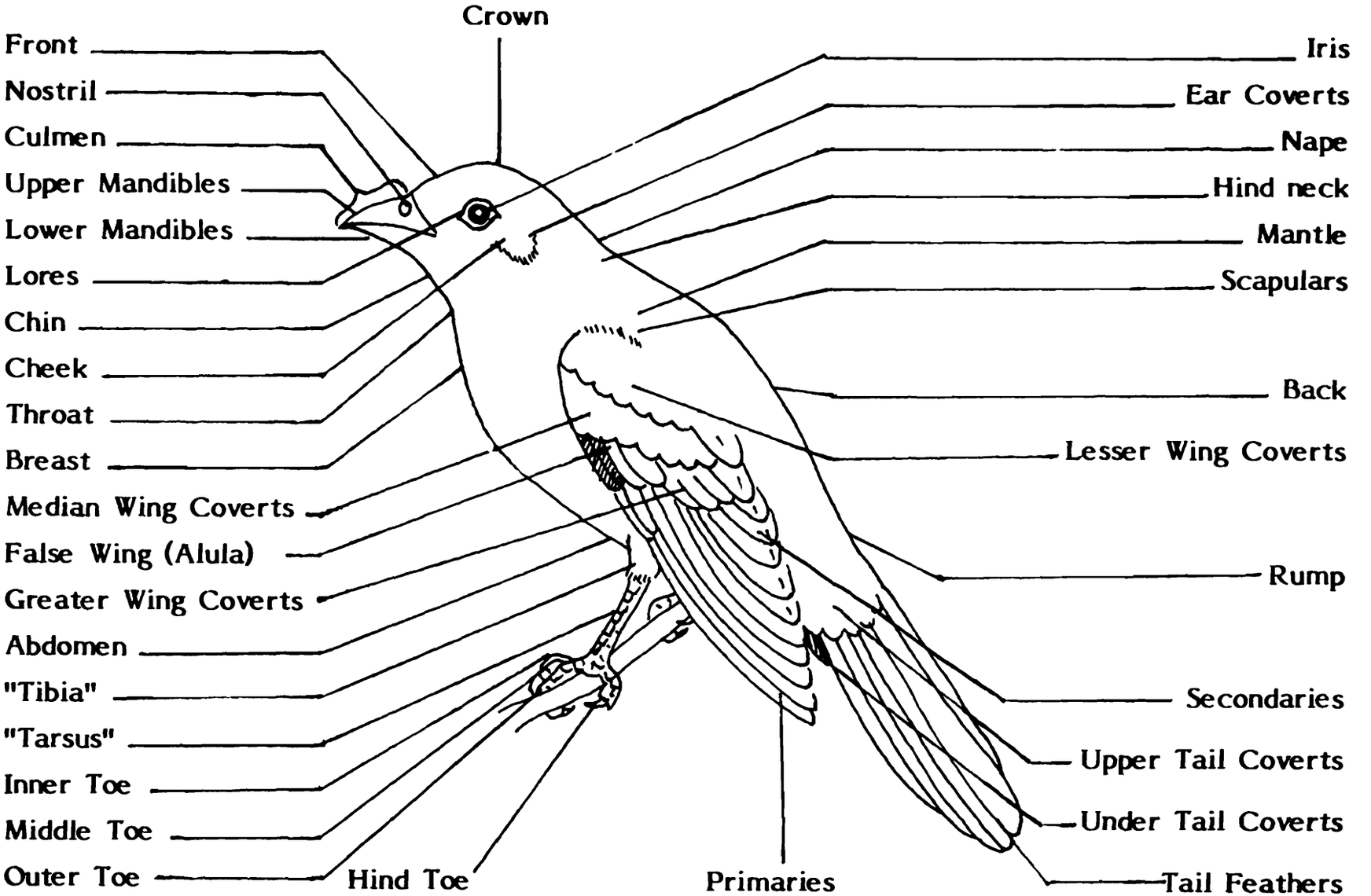


Figure 3. External Morphology.

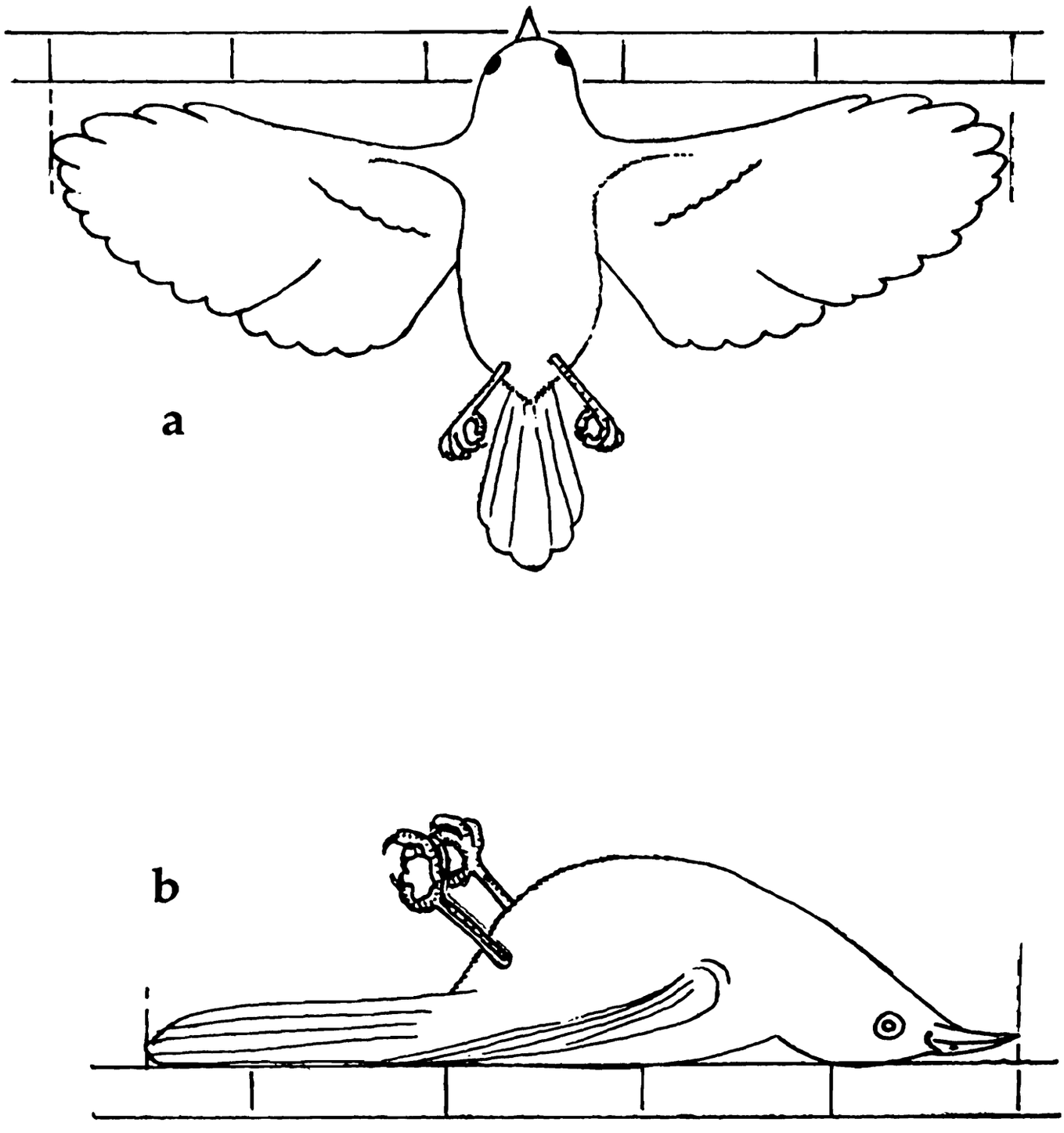


Figure 4. Body Measurements
a — Wing-spread ; **b** — Total body length.

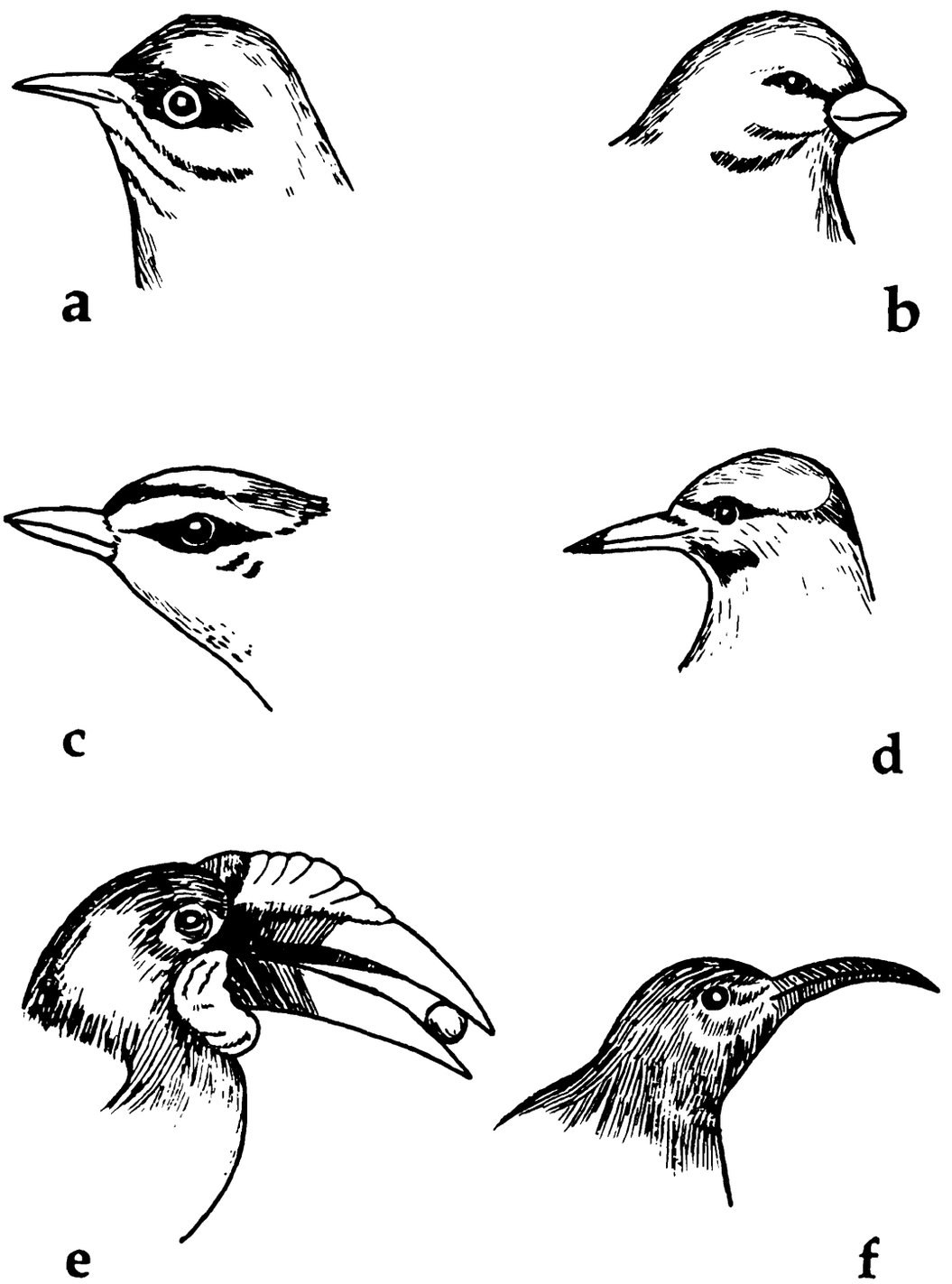


Figure 5 — a-f. Modification of beak in different birds :
a — Thrush ; b — Bunting ; **c** — Warbler ; **d** — Flicker ;
e — Hornbill ; **f** — Hummingbird.

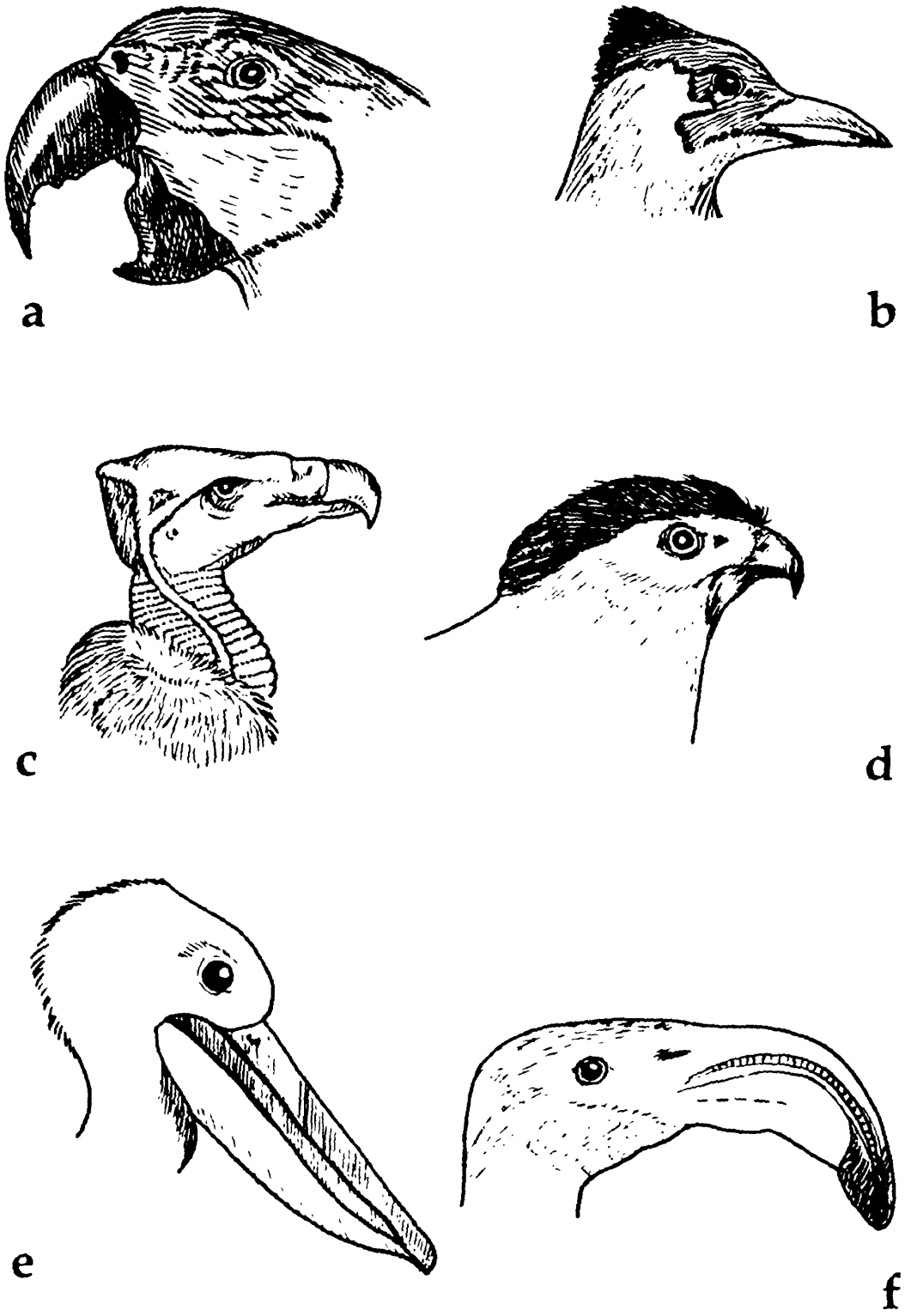


Figure 6 — a-f. Modification of beak in different birds : **a** — Parrot ; b — Woodpecker ; **c** — Vulture ; **d** — Hawk ; **e** — Flamingo ; **f** — Pelican.

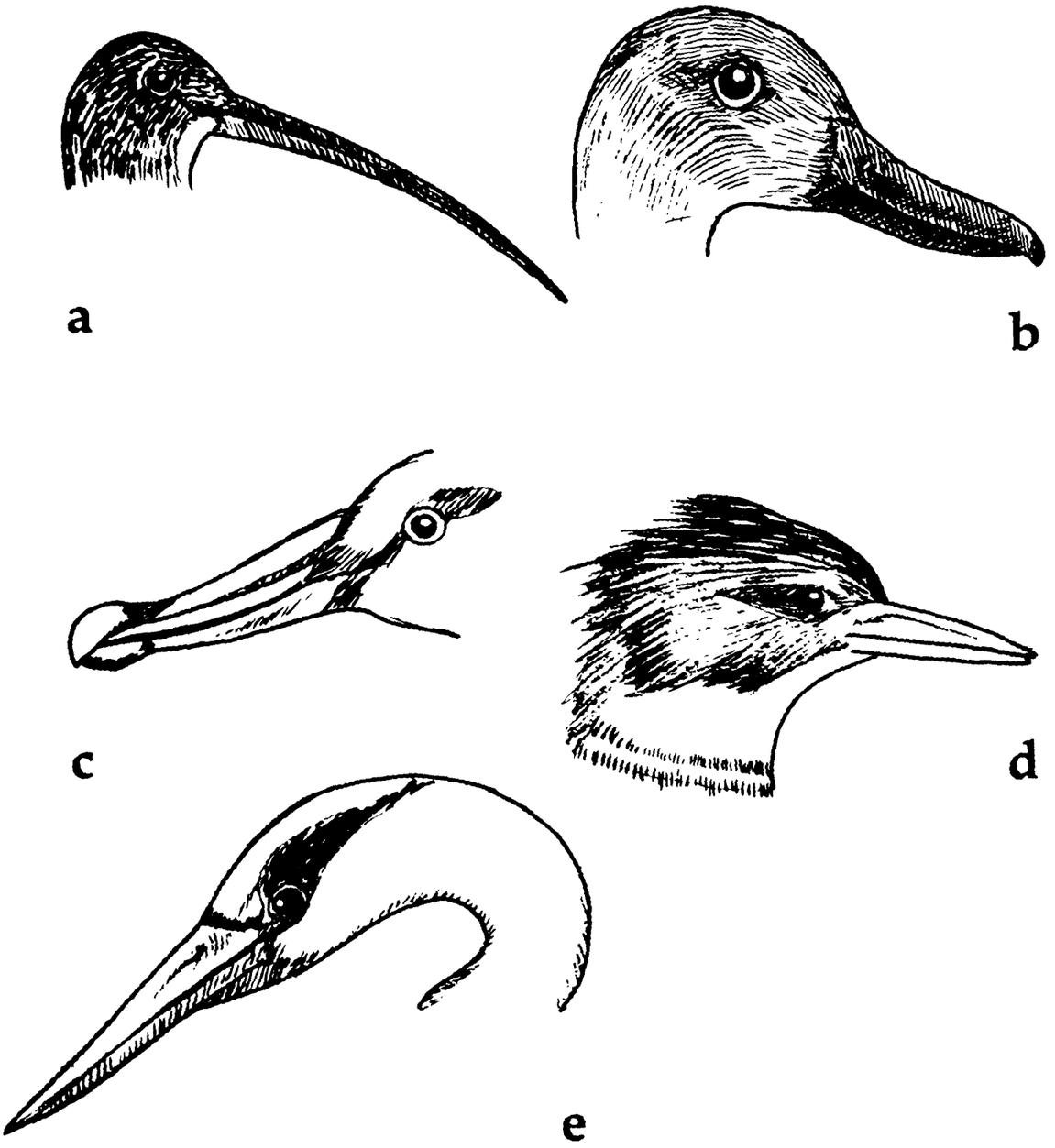


Figure 7 — a-e. Modification of beak in different birds :
a — Sandpiper ; b —Duck ; **c** — Albatross ;
d — Kingfisher ; **e** — Heron.

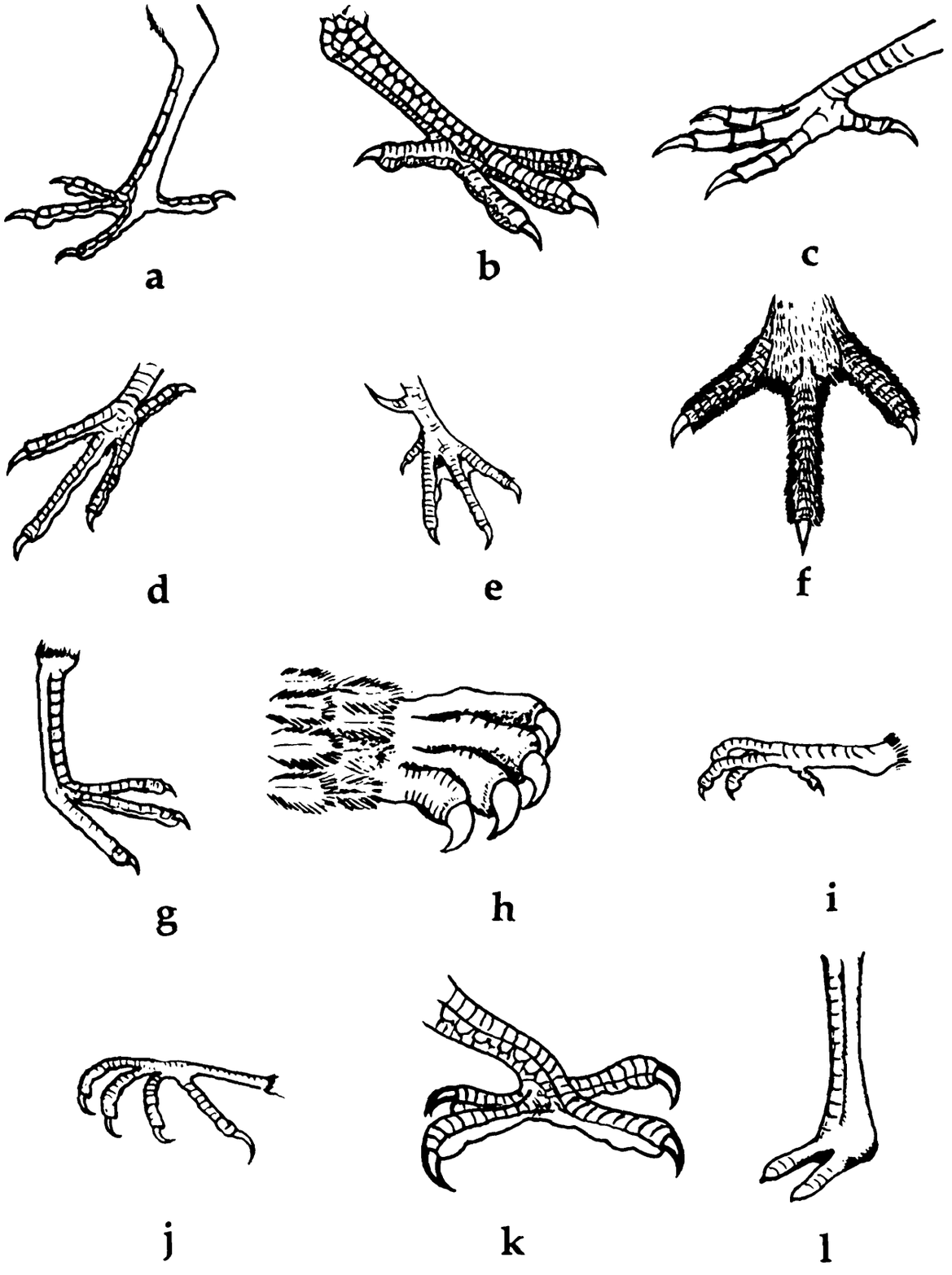


Figure 8 — a-l. Modification of hindlimb in different birds : **a** —Weaver; b — Megapode ; **c** — Finch ; **d** —Poorwill ; **e** —Jungle-fowl ; **f** — Sage-cock ; **g** — Button-quail ; **h** — Swift ; **i** —Kingfisher ; **j** — Tree-creeper ; **k** — Woodpecker ; **l** — Ostrich.

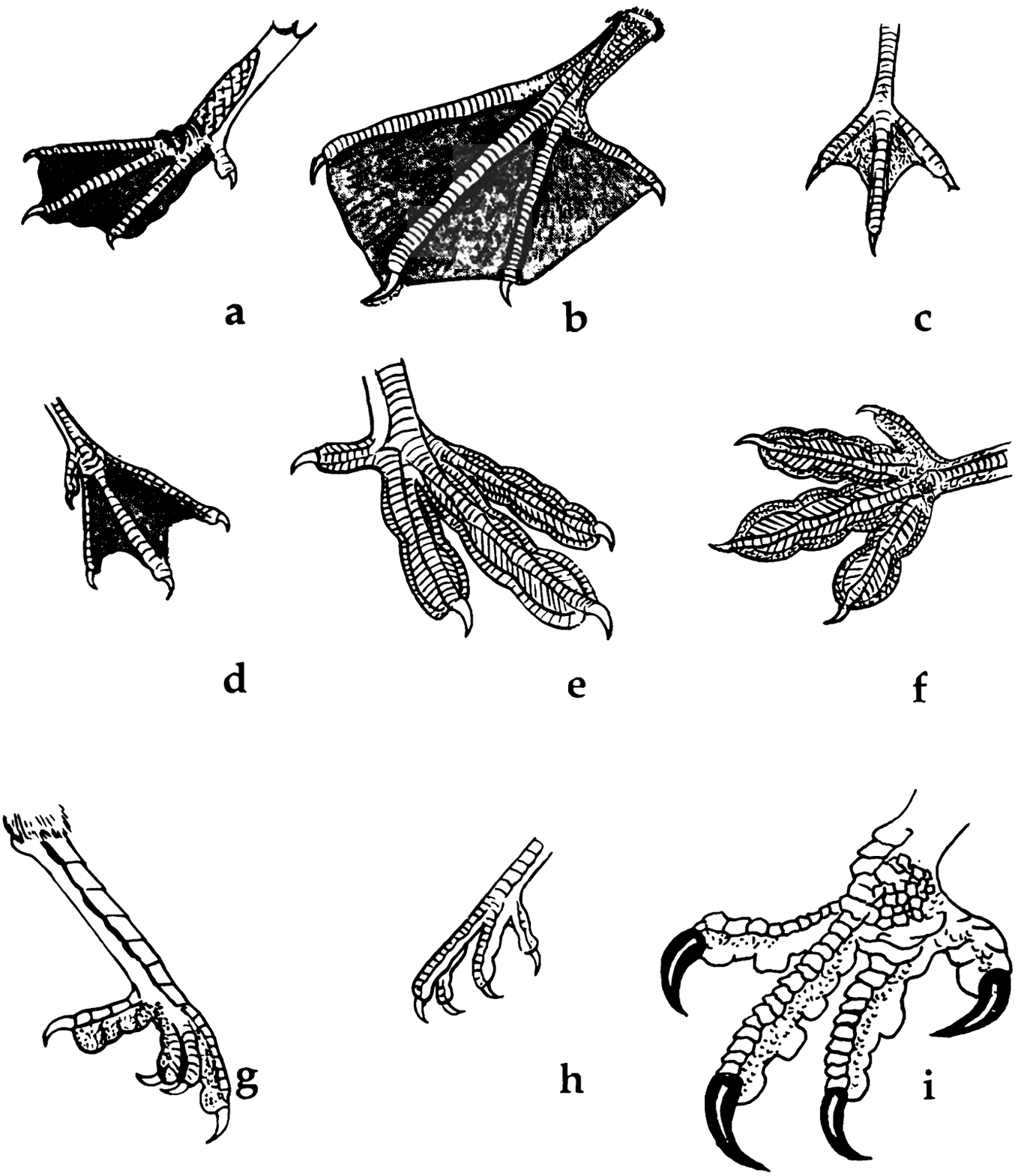


Figure 9 — a-i. Modification of hindlimb in different birds : **a** — Duck; b — Cormorant ; **c** — Swift ; **d** — Tern ; **e** — Grebe ; **f** — Coot ; **g** — Raven ; **h** — Pigeon ; **i** — Hawk.

Chapter 5

SURVIVAL

Birds can fly in air like most efficient flying machine. A few species have secondarily lost their ability to fly but have adapted alternate methods of dominance. Many birds can efficiently swim and spend lot of time on water, others can dive deep in water to catch the prey. Birds during flight fully utilize air currents to conserve energy by hovering mechanism. Birds are provided with exceptionally efficient vision, which can scan the distant places to locate their food while in flight.

One and each of these adaptations help the birds to survive efficiently. In the following pages factors responsible for their survival are discussed in details.

BIRDS : MAGNIFICENT FLYING MACHINES

The birds constitute a highly specialized group of vertebrates which have attained the peak of evolutionary perfection. Almost every part of their body has been modified for an aerial mode of life, but those few who can't fly have evolved other methods of survival such as powerful legs to run (Ostriches) and paddle-like wings to swim in water (Penguins).

Most of the birds have very well developed wings. They are magnificent flying machines and can fly like an airliner. An aeroplane has to run at a great speed and a long run-way before take off. To take off and to fly through the air, it has to have very powerful engines. Its landing is more hazardous because of great landing speed. But most birds can hop into the air without a runway, can turn in any direction without any difficulty at great speed and simply alight on any branch they choose.

The birds and aeroplanes fly on same principles. To move forward they have to push the air backward. The birds flap their wings up and down to push the air backward and downward. The wings and rudder of aeroplane have flaps that move

to help it turn, but a bird can move the feathers in its wings and tails to make all kinds of movements. During the downward movement of wings, the feathers close to help push the air. During the upward movement, the feathers spread out to let the air through.

Birds are the fastest animals in the world. The Spinetailed Swift can fly at a speed of 170 kilometres an hour, because it has narrow body and very powerful wing muscles. Penguins can not fly in the air but their stubby wings serve as paddles to wade through the water.

Flying takes up a lot of energy, but those birds which are always flying in search of food or catching food on wings have ways of flying which do not require much of that, they glide through the air without flapping their wings.

To rise in the air these birds, such as vultures and eagles, seek a rising warm current of air. When the bird strikes such a current, it circles in it and is carried upwards. Albatross is an example that soars over the sea for months. Humming birds hover in front of flowers so that they can insert their long beaks to get the nectar. They beat their wings rapidly yet remain poised to one spot. So good are humming birds at flying that they can even fly backwards. Probably the fastest metabolizing vertebrate on earth, is this tiny humming bird. While hovering it consumes about 80 cubic centimeters of oxygen per gram of body weight per hour. Even at this rate its metabolic rate is more than 50 times as fast as man's.

Interestingly enough, the hovering humming bird uses energy at about the same proportionate rate as a hovering helicopter. This does not mean that man has equaled nature in the efficiency of energy yield from fuel. To hover, the humming bird requires a great deal more energy, because of the aerodynamic inefficiency of its small wings and its very high loss of energy as dissipated heat. The tiny wings of a humming bird impose, on the bird, an almost incredible expenditure of effort. Its breast muscles are estimated to be approximately four times as large as those of a pigeon. This great muscle burden is one price humming bird pays for being small. Man still has far to go to approach such efficiency.

BIRDS : UNDER WATER

The birds are adapted according to the environs they live in and the food they eat. These adaptations enable them to live in a particular place with full comfort. Many birds are as much at ease in water as they are in air. They eat insects, fish, water plants, etc. by catching them under water.

Some birds swim on the surface of water and lower their head into the water to feed. Such birds spend most of their time in water viz., ducks, gulls and swans. There are other birds, who go into the water only to catch fish or insects. They dive into the water from the air. Such birds seldom stay under water very long. Gannets plummet from a great height, half closing their wings as they enter the sea with a great splash. The Terns fly low over the sea and they plunge in when they spot a fish. The kingfisher darts in a flash to spear a fish.

Other underwater birds make long dives from the surface. Penguins are happier under water than on the surface, occasionally surfacing for air. They can dive deeper than 250 metres and remain underwater for as long as 18 minutes. These diving birds either push themselves forward with their wings, 'flying' underwater and steering with their feet, or they swim with their feet and turn with their wings. One of the most unusual underwater birds is the Dipper which lives in rivers. It looks like a woodland bird, but it can swim underwater by using its wings. It can even walk along the bottom of a river.

BIRDS : WITH SHARP SIGHT

Birds are highly adapted to their mode of life. They are not only different because they can fly. They are also different because they have a good eyesight. Most mammals depend on smells, and sniff their way about, their eyesight is important but they do not totally depend on it. A bird that loses its sight is completely helpless.

Birds have a very keen sight, much keener than that of a human being. They use their eye sight in two basic ways. Firstly, to look for food and secondly to keep a watch on enemies. The birds have comparatively large eyes. The position of the eyes on the head has great relevance to their habit and habitat.

The hunters or other birds of prey, such as owls, have their eyes placed on the front of the head, like human eyes. When both the eyes are placed in front, they can see things in depth. This is very helpful in catching moving objects.

In many birds, the eyes are placed on either side of the head, such as seed-eaters or those which dig for grubs and worms. This greatly helps them to keep a sharp watch on enemies such as hawks and cats, while they are busy feeding. The eyes placed on either side of the head helps them to a full view all around.

Because of their sharp and perfect vision, a thrush can spot a hawk in the sky and at the same time the hawk will be able to see the thrush on the ground far below. The birds have very sensitive vision. They can see (viz. Owl) in light which appears almost dark to us. The birds are not colour-blind. Night hunting birds may not be able to see colours, but other birds can see colours in the same way as we do. In fact they often recognize each other by the colour of their feathers.

The water-inhabiting birds can see things under water clearly. For seeing under water, they have transparent eyelids that act as contact lenses.

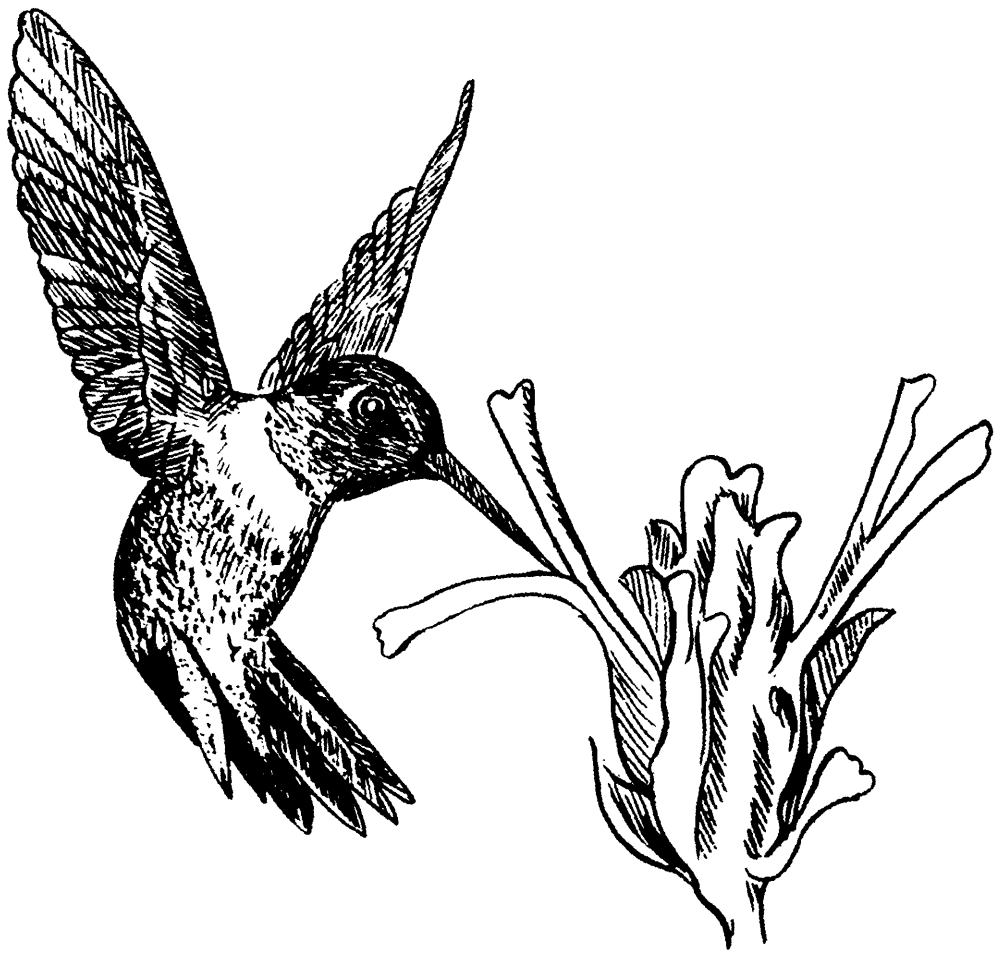
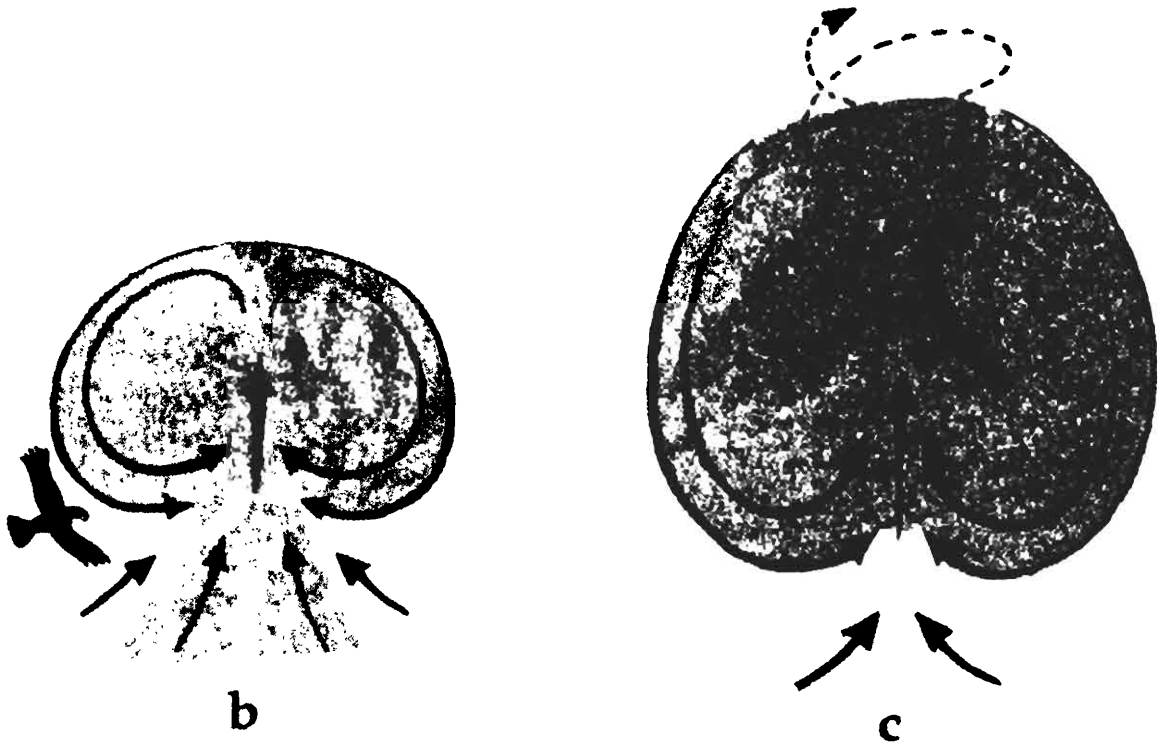


Figure 10. A Hummingbird feeding on nectar while hovering in front of a flower.

a



b c

Figure 11 —a-c. Hovering mechanism in birds :
a — Hawk hovers high in the air ; **b** — a bird of prey flies into a rising air current ; **c** — bird being carried upwards in circles.

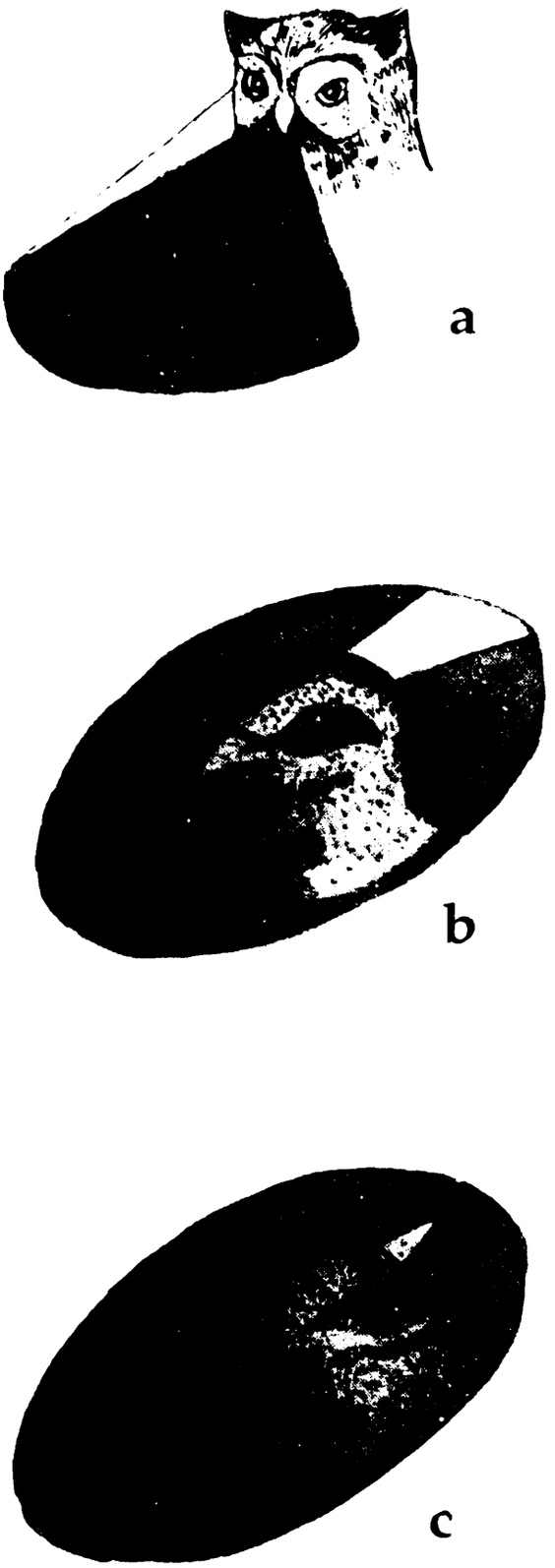


Figure 12 — a-c. Position of bird's eyes on its head :
a — Frontal ; **b** — Fronto-lateral and **c** — lateral positions.

Chapter 6

MIGRATION AND NAVIGATION

It is a well known fact that a number of birds travel very long distances, up to 13,000 km. This phenomenon is called the migration. Scientists have put forth a number of theories to explain bird migration, which is so precise that a given species keeps on migrating between two fixed distant places through generations. Not only that the path on which they travel is fixed but the season, and in certain cases the dates of occurrence of a particular bird species in a given locality are more or less constant.

Why do the birds migrate? It is a proven fact that migration is either for food or for breeding or overcoming unsuitable climatic conditions, like severe winter or drought. Bird migration is more an instinct than their decisive behaviour. Navigation of birds during migration is due to relative solar or lunar positions or magnetic field.

It is a well known fact that European birds migrate to Africa for wintering. It was believed—as the great Aristotle wrote that swallows and other small birds spend winter at the bottom of ponds where they lie buried in silt; or under the bark of trees or in old tree hollows; or turn into hawks to which it bears a strong resemblance in colour of plumage and flight.

But slowly the truth came to light. Birds had failed to keep the secret of their mysterious disappearance from the inquisitive eye of man. A serious study of the migration of birds was started as late as the end of the 18th century at the initiative of the Swedish naturalist, Carolus Linnaeus who suggested that simultaneous observations of birds of passage and the routes of their migration should be carried out in different parts of Europe. This idea proved fruitful and yielded valuable evidences.

Martensen, a school teacher from Denmark, proposed to put rings on their legs. Leonard Frisch wound a red thread around a swallow's leg, which he caught after a year and

examined the thread; its colour did not fade and there was no trace of silt on it, therefore, it was concluded that the swallow had not wintered on the bottom of a pond. Mertensen improved the methods of ringing after considering many data. He finally used rings of light metal, inscriptions on them indicated where they should be returned if a ringed bird is captured of killed. More than ten million birds were ringed; and of these at least one hundred thousand had been returned with more or less accurate indication of the place of its capture. Based on this information, ornithologists plotted lines to show the routes followed by birds, driven away by the cold breath of the northern winter.

A good number of birds living on Earth (about 1/5) do not stay at one place in spring and autumn. When free from their duty of raising their young, non-migratory birds too, leave their nests and scatter through forests, fields far away from their homes. Birds which have wintered in the South return to their northern homeland in spring. The Antarctic skuas winter in Japan, and the bronzed cuckoos from New Zealand, on the Solomon Isles. Several American birds hatch their young in Patagonia and seek protection from the cold in the north, in the tropics of the New World.

The slender-beaked Storm petrels hatch their young on Tasmania Island and then migrate northwards and a month later can be seen near the shores of Japan; from here they fly further to Kamchatka peninsula and Alaska. They cross the whole width of the Bering sea and return to North America. Once again they direct their course towards the open sea and soon close their famous Pacific loop'landing on their nest which they had left last southern autumn. How do they find it after such a long absence? Why do they fly so far : isn't there plenty of fish in the southern hemisphere? Science is unable to answer these questions so far. It is also a mystery why several tropical birds, which are not threatened either by cold or hunger, set out on a long journey after raising their young.

MIGRATION ON FOOT

It is not always that birds travel to distant lands on wings. Many of them travel on foot, such as the wild turkey. It flies only over rivers, and for hundreds of miles treads the ground all along the way to its winter habitat in the south. The most enthusiastic pedestrian is the Landrail. It covers on foot most of the distance from Russia to South Africa. The wingless Auks, now extinct, used to swim from Iceland and Greenland to coasts of America and Europe, and then travelled along both the Atlantic coasts to France and South Carolina for winter. These auks no longer exist, but sea-faring birds, and not only Penguins, still traverse sea and oceans.

The Loons swim and reach the northern coast of the Taimyr Peninsula through the Siberian rivers, enter the Kara Sea and turn westwards. They swim further across the sea entering into the Barents Sea, and swim further until they reach the coast of Scandinavia. They move further along the entire length of Scandinavia beyond which they enter the Northern sea and then the Baltic Sea. Here their journey comes to an end. It is a gruelling task to travel over 5000 kilometers from Taimyr Peninsula to Baltic, mostly swimming.

ARCTIC TO ANTARCTIC ON WINGS

The Polar Terns in autumn leave the Tundra for the warm southern countries. The regions, where they winter are only relatively warmer. Indeed, these incorrigible cold addicts, winter also in polar regions, but on the far side of the globe in the Antarctic. From Canada and Greenland the Terns fly at first to Europe and travel to Africa along the coasts of France and Portugal. Near Senegal and Guinea their routes diverge. While some birds turn westwards in the direction of Brazil, from where they fly to the Falkland Islands, others remain loyal to Africa and after passing Cape of Good Hope take a straight course to the Antarctic.

These Polar Terns, twice in a year, from Canadian tunda to Antarctic, cover a distance of about 19,000 kilometers.

NAVIGATION

Five thousand years ago people already knew that pigeons and swallows can excellently orient themselves and always find their way home however far they may fly away. When this ability of birds was discovered, people began to catch them and train them for simple jobs of postal services. Pigeon post has a venerable history of its own. The Egyptians, ancient Greeks and Romans sent pigeons with messages. Even today millions of homing pigeons are used for postal service.

Is it memory?

It goes without saying that memory plays a definite role in this process, helping the birds to find its way home quickly by familiar landmarks. But was found later that memory is only of auxiliary importance; pigeons trained to come back along a definite route sometimes deviate and fly home through shorter, unfamiliar route.

During some experiments, birds were rotated on a gramophone disk or carried under general anaesthesia throughout the journey to rule out the influence of the so-called kinaesthetic sense, which enables the birds to memorize mechanically all the turns of the vehicle in which they are taken to the place of their release, (so that they only have to unwind the coil of their recollections in opposite direction and bring their wings in conformity with them, and they will hit on the right way). But even after general anaesthesia and merry-go-round the birds just well oriented themselves in unknown lands.

Several experiments have been carried out with a variety of birds, and all of them found their way home from unknown localities more or less successfully. It proves that it is something more than memory, which helps them. But what helps them then?

Is it spiral movement?

Some investigators have come to the conclusion that birds do not come back for so long because they look for similar landmarks *en route*, flying over the locality in spirals and gradually widening the circles. A circular route naturally, takes a much longer time than a direct route. The theory of random

search is now losing its weight. As it is proved that birds usually fly slow, covering about 100 kilometres or about 200 kilometres a day.

When en route the birds feed, rest, clean themselves, which takes quite a lot of time. Similarly, there are several observations which will prove that the theory of spiral search is wrong. Self-navigation to home from far-removed localities always proceeds along a straight course.

Are they guided by veterans?

It was commonly believed that young birds were guided on their way to the southern countries and back by older birds. Now we know that with many bird species the young ones, as soon as they have learned to fly, start on their south bound journey on their own, without their parents and even adult birds in general.

A few thousand young white storks were caught where they had grown up until the time when all their relatives had left this locality. These were taken captives and banded, and set free. They immediately headed south-east, that is where, the adult storks from the Baltic region winter.

Such experiments were carried out with many birds, with the same result young birds, which had been carried away from their native place went nevertheless in the same direction as their parents had followed. This means that they have an inborn sense of direction. It is interesting to note that, if the eggs or hatchlings are transferred to another locality and reared there, next spring they will not return to the land of their ancestors, but will fly where they were reared and from where they had their first flight. This instinct and memory of the route are present in them since birth. However, it is not enough to have only an instinct to fly in a predetermined direction, it should be guided by a compass. To understand the nature of this compass, the magnetic theory was widely accepted but later rejected.

Magnetic field and Coriolis forces theory :

Middendorf (1855) suggested that birds are guided by the earth's magnetic field. Scientists failed to convince people ex-

perimentally that birds are guided by earth's magnetism. The coriolis effect due to earth's rotation manifests itself when the body is moving on the earth surface or flying over it. Owing to this effect, in the northern hemisphere any moving object tends to deviate to the right, and in southern hemisphere to the left. Science refuted one after another all the hypothesis which attempted to explain one of nature's greatest mysteries.

Solar Navigation :

Sun navigation of birds has been investigated by many research workers since Kramer demonstrated fluttering orientation of Starlings owning to altering day length, hormonal changes occur in a bird that bring it into a migratory condition. When caged, such birds become hyperactive and hop and flutter in the direction that would fly if free to migrate. This oriented behaviour occurs only when the sun is visible, and the direction of fluttering shifts a predictable number of degrees when the image of the sun is displaced a known amount by mirrors. This finding demonstrates that direction is determined in response to the sun; it does not prove true navigational ability, which demands, in addition, at least assessment of latitude.

If the sun or the stars are to be used as guides to navigation, the organism must possess an internal biological 'clock' As the sun moves across the sky, bird is able to maintain a straight migratory course over the surface of the earth only if it can compensate for the movement of the sun; thus with the aid of its clock, the bird continually alters the angle between the sun and axis of migration.

There are certain birds migrating at night and resting in the day time. A fairly large number of such birds are known. Although these birds travel at night they orient themselves by the sun all the same. They are supposed to choose the right course at sunset and keep it in memory through the night.

The theory of sun navigation is a great triumph of scientific thought, yet not all the positions won by he science have been firmly reinforced by human-knowledge. Scientists are still unable to explain how birds crossing the Equator continue to orient themselves by the position of the sun. This is the wea-

kest point in this theory. A bird flying in the direction of the sun is heading southward. When it has crossed the equator, the sun will be behind its back and to continue on its southernly course, it has to fly away from, rather than towards the sun. Is it possible for the instinct to change so rapidly as to enable the bird to adapt itself immediately to seeing its guide in the north instead of the southern skies? Some experiments carried out with bees have thrown some light on this question.

When bees had been taken from the northern to the southern hemisphere, their physiological clocks, helped them to take their bearings just like that in their native land, adjusting their flights for nectar and back to the hive to the clockwise movement of the sun. This means that animals with less complex organisms than those of birds can readjust all their navigational reflexes to new conditions within a matter of a few days. This probably occurs with birds as well.

TABLE SHOWING DETAILS OF SOME MIGRATORY BIRDS

Species	Length cm (Inches)	Breeding area	Wintering area	Distance Flown KM (Miles)
Arctic Skua (Parasitic Jaeger)	42 (16 1/2)	Arctic America, Greenland, Arctic Europe, North Siberia	West Africa, Persian Gulf, Arabian Gulf, Australia, New Zealand, South America	6500-13000 (4000-8000)
Arctic Tern	35-38 (14 15)	North Canada, Greenland, Iceland, North Europe	South and West African coasts, Antarctica	18000 (11000)
Arctic Warbler	12 (4 3/4)	North and north-east Europe, north Siberia	South-east Asia	6500-13000 (4000-8000)
Blackpoll Warbler	12 14 (5 5 1/2)	Alaska, east to Northern Labrador and New England	Colombia, Venezuela to French Guiana	4000-8000 (2500-5000)
Black and white Cuckoo	33 (13)	India	East and south-east Africa	5500-7000 (3500-4500)
Blue-cheeked Bee-eater	28 (11)	North India, west China	East Africa	6500-9000 (4000-5500)
Bobolink	16-20 (6 1/2-8)	South-east Canada, north-east and mid-west U.S.A.	Bolivia, Paraguay, Brazil	8000 (5000)
Buff-breasted Sandpiper	19 (7 1/2)	Arctic Canada	Argentina and Uruguay	9500-1300 (6000-8000)
Willow Warbler	11 (4 1/2)	Eurasia	East Africa	13000 (8000)
Great Shearwater	43-46 (17-18)	Tristan da Cunha	North Atlantic	Oceanic wanderer
Long-tailed Cuckoo	42 (16 1/2)	New Zealand	Samoa and Fiji	3200 (2000)
Manx Shearwater	35 (14)	British Isles, Brittany Atlantic Islands, Mediterranean	South Atlantic	8000 (5000)
Needle-tailed Swift	19 (7 1/2)	East Siberia, Japan	Australia, Tasmania	8500-13000 (6000-8000)

Species	Length cm (inches)	Breeding area	Wintering area	Distance Flown KM (Miles)
Pacific Golden Plover	25-28 (10-11)	West Alaska, north-east Siberia	Hawaii, Tonga, Indonesia, Australia	9500-13000 (6000-8000)
Pintail (New World)	56 (22)	North-west Alaska east to Hudson Bay, south to Iowa, N. Colorado, S. California	Middle and southern United States to West Indies and Panama, west to Hawaii	1600-6500 (1000-4000)
Ruff	22-30 (8 1/2-12)	North and west Europe, Siberia	West Europe, Africa Iraq, Iran, India, Sri Lanka	5000-9500 (3000-6000)
Sandwich Tern	40 (16)	Shores of North Sea and west Mediterranean, Black Sea	West and South Africa	1600-8000 (1000-5000)
Scarlet Grosbeak	15 (5 3/4)	North-east Europe	India, south-east Asia	5000-9500 (3000-6000)
Shining Cuckoo	18 (7 1/4)	New Zealand	Solomon Islands	2900 (1800)
Lesser Snow Goose	63-71 (25-28)	Alaska, North-west Canada	Gulf of Mexico, California	3000-5000 (2000-3000)
Sooty Shearwater	40 (16)	New Zealand, Falkland Is., Cape Horn	North Atlantic, North Pacific	Oceanic wanderer
Summer Tanager	17 (6 1/2)	North America, north to as far as the Great Lakes	Mexico southwards to Peru	1600-6500 (1000-4000)
Swallow (European)	18-19 (7-7 1/2)	Europe, north to about 68°	Central and South Africa	8000-11000 (5000-7000)
Tiger Shrike	18 (7)	China, east Siberia, Japan	Malaya, Sumatra	5000-6500 (3000-4000)
Wandering Albatross	112-135 (44-53)	Tristan da Cunha, Gough Island	Southern oceans, chiefly south of 40°S.	Unknown
White Stork	101 (40)	Mid-Europe	Tropical and South Africa	5000-8000 (3000-5000)

Source Reader's Digest Great World Atlas, 1977

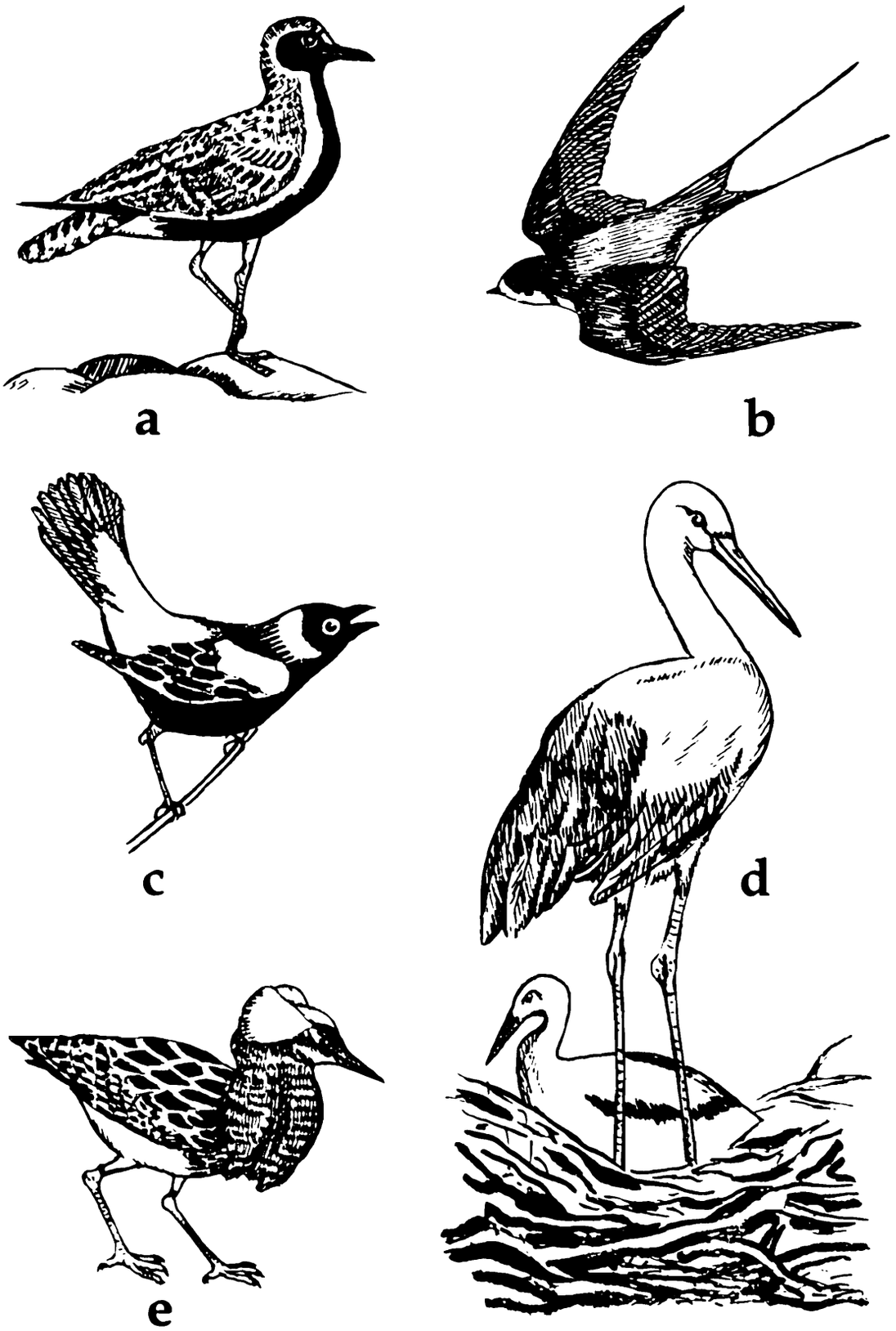


Figure 13 — a-e. Migratory Birds : **a** — Golden Plover ; **b** — Swallow , **c** — Bobolink ; **d** — Ruff ; **e** — White Stork.

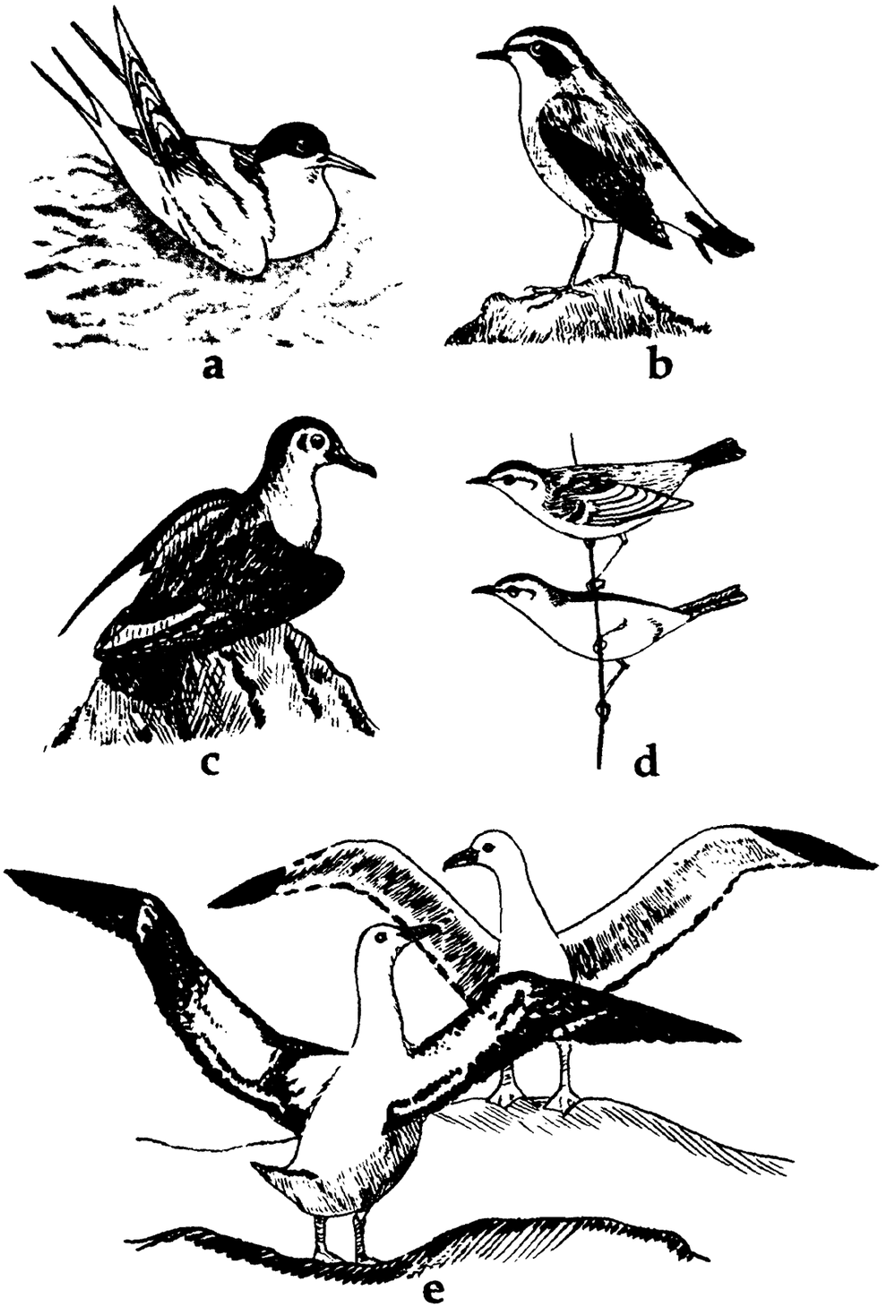


Figure 14 — a-e. Migratory Birds : **a** — Arctic Tern ; **b** — Wheatear ; **c** — Sooty Shearwater ; **d** — Arctic Warbler, Willow Warbler ; **e** — Wandering Albatross.

Chapter 7

THE MAGIC OF BIRDSONG

There is no sound more welcome than the songs of birds. This is not only because of its varied beauty but for a deeper reason. Bird song is a language, one without words, but with a meaning. Its magic comes bubbling out of the deepest sources of springtime well-being.

The birds are made to sing. Humans have a larynx for their vocal utterance, birds have a syrinx, a tiny delicately articulated voice box which can produce the rolling trill of the Canary and perfect notes of the Hermit thrush. Why do birds sing? One of the most precise answers is that a bird sings in order to stake out a claim to his bailiwick for nesting. The migrating males, arriving first in the spring-time, proclaim a certain territory as their own. As the females come winging from the south, the males announce with their songs that they are owners of the territories, ready to set up housekeeping.

The male sings through the nesting season, perhaps to please his lady. With the hatching of the nestling, songs lessen, as the bread winner and grub gatherer, the father bird has less time for singing.

The bird sings at his chosen moment, at a certain time of the day, as well as the time of year. Some birds, like the Vesper sparrow, are drawn to sing with the coming of dusk, others, like the Whippoorwill, are vocal only at night. But Nightingales sing both by day and night.

The marvellous spontaneity of bird song is a mystery. Careful studies by ornithologists, using tape recorders and electronic devices, give us a paradoxical answer. It has been concluded that the simple call notes of a bird are born in him when he is hatched, but the true song may be partly inherited or partly learned, or entirely learned.

W.H. Thorpe and his team of researchers at Cambridge University have found that when a young Chaffinch is taken

from the nest and reared alone, it sings but a poor and restricted version of the song of its kind in the wild. This may be taken as inherited song pattern. But given the prisoner in solitary confinement a fellow Chaffinch, his song improves as he listens to his companion. The Cambridge Ornithologists found that what the bird learnt in its youth was fixed for life. It did not seem to matter what the bird heard thereafter.

Some birds incorporate in their singing, the songs of other species. The Jay and the Mockingbird have a reputation for imitation. A caged bird in a house or in an office imitates perfectly not only the squeak of a chair, whistle for a dog, but, also the sound of the children knocking at the door and calling to be let in.

It is understood that a bird song is a sort of emotional release rather than the process of communication. The possibility of birds singing for pleasure is by no means ruled out.

Chapter 8

RARE AND VANISHING SPECIES

Certain species on earth whether insects, birds or mammals share an unusual fortune or misfortune. Some have been living together on the Earth from the earliest times. Some have perished, even at their fullest tide of life. Some live at great heights, at great depths or in other climates formidable to man.

Each year in this modern era one or more wild animal passes into oblivion as man continues to hunt, bulldoze marshes, pave woodlands and disregard the needs of wildlife. During the last 2000 years 245 species of animals including 139 of birds have already been extinct, almost a third of them in the last 50 years. At present about 600 or more of mammals alone are threatened, of their existence. The passenger pigeon has become extinct in very recent years. Hunting the wild during breeding season and not limiting the bill, the hunters plunged their populations so low that they have almost vanished from the Earth. The Whooping Crane is facing the same fate—on and on down the list of 600. And if this continues the extinction of others is only a matter of time.

It is universally accepted that the excessive growth of human population and exploitation of natural resources have brought about an imbalance in nature. The rapid urbanization, construction of buildings and roads, and encroachment on vast areas of forest lands for extension of agriculture are the largest set of factors threatening the ecosystems and wildlife in general.

It is a relief to note that the world opinion is now in favour of tackling the problem of maintaining the ecosystem on a priority basis for environmental improvements. The threat to the biosphere and its living components are now on decline in the greater parts of the world.

As far as India is concerned a number of measures have been taken by the Government to conserve whatever remains of our wildlife from the depredation of human greed. Killing and trap-

---

Artide by Shri J.M. Dasgupta, Zoological Survey of India

ping of endangered species have been prohibited and exploitation of other species has been regulated. The rules and regulatory provisions are laid down in the Schedule I (totally protected) and Schedules II-IV (controlled exploitation) of the Indian Wildlife (Protection) Act, 1972, and the subsequent amendments. Mammals, birds and reptiles compose the major part of wildlife of which birds are dealt herewith.

To facilitate identification of endangered species of 47 birds in India, a brief account of some 12 rare and endangered species of birds is given here. Species discussed here are drawn from the lists in Schedules I and II of the Indian Wildlife (Protection) Act, 1972.

1. **Large Whistling Teal.** ***Dendrocygna bicolor*** **(Vieillot)**
Length c. 51 cm.

A small, pale brown and chestnut duck with rounded wings and stout legs. Differs from the Lesser Whistling Teal (*Dendrocygna javanica*) in having a broad rusty whitish collar on foreneck, and the creamy white upper tail-coverts instead of chestnut. It is found in small flocks, frequents swamps and settles in trees. Sometimes found in mixed flocks with other ducks. Neck often outstretched when alarmed. A quick swimmer and an expert diver. Prefers vegetable diet in addition to a small quantity of snails, worms, etc. Call specific—a regular shrill wheezy whistling '**seasick seasick**' Breeds during monsoon, nesting in hollows of old tree trunks, sometimes on ground among vegetation on the edges of tanks. A resident of the Indian subcontinent. Widely distributed in the tropics of the world. Found practically throughout the Indian region, but more common in eastern India, especially in Assam and Bengal. Reported to breed in Nadia district of West Bengal and adjoining districts of Bangladesh, but now status sparse excepting in north eastern Assam and Tripura. Once common but at present endangered due to shrinkage of its habitat.

2. **Pinkheaded Duck.** ***Rhodonessa caryophyllacea*** **(Latham)**
Length c. 60 cm.

A shy and secretive forest duck with distinctively bushy bright pink head and bill. General body plumage and wings black with a

pinkish buff speculum. Female duller than male. Confusable with Redcrested Pochard (*Netta rufina*) which bears an orange-red head. Inhabits dense sub-montane grassy jungles along the Terai and Duars. Formerly ranged from Uttar Pradesh through Bihar to Assam, Manipur. Recorded from Punjab, Orissa, Maharashtra, Andhra, Tamil Nadu in winter. Present distribution not known. Probably extinct in India. During the last 75 years its population started declining due to gradual shrinkage of its habitat and duck shooting. Last reliable recorded in 1935 from Darbhanga district in Bihar by C.M. Inglis. Also recorded from Manroopa Lake in Bihar in 1947, that needs confirmation.

3. **Whitewinged Wood Duck.** ***Cairina scutulata*** **(S. Müller)**
Length c. 81 cm.

A black and chestnut-brown perching duck with orange yellow bill, legs and feet. Head and neck spotted black and white. Similar to the Comb Duck (*Sarkidiornis melanotos*) but lacks a comb on bill, and lower parts chestnut. Wing-coverts marked with white. Lives in the tropical evergreen forest, spending much time perched on tall trees, but flies to marshy pools and streams in the evening. Rather wary, a strong flier, omnivorous, nests in hollow trees. Vulnerable, resident within the Indian limits recorded from the eastern districts of Assam, and Siang, Lohit and Tirap districts of Arunachal Pradesh. Declination in numbers due to direct and indirect interference by man. Assam Wildlife Society (1976) estimated 44 birds in the whole of Assam.

4. **Megapode.** ***Megapodius freycinet*** **Blyth**
Length c. 43 cm.

A domestic hen-like bird with a short tail and rounded wings. General plumage colour brown with an olive wash, sides of the head red and bare; legs long, darker in front and reddish on back, feet provided with long straight claws, hind toes well developed. Inhabits tropical moist dense forest along the sea-shores. Moves along the undergrowth in pairs or in family parties in search of food. When alarmed takes shelter under dense forest cover; remarkable for its nesting habits—mounds made of sand, leaves and vegetable matters, generally built in the forest near the beach ser-

ves as the nest in which several hens lay their eggs. Breeds throughout the year. No incubation extended by the female, heat generated by the deposited compost helps in incubation. Within the Indian limits found in the Nicobar islands only. Regarded as endangered species. Population getting reduced due to regular hunting and egg collecting by the recent settlers.

5. **Monal Pheasant.** ***Lophophorus impejanus*** **(Latham)**
Length c. 72 cm.

A brilliantly coloured stout pheasant with an upstanding crest of wire like spatula-tipped feathers. Male looks almost black having conspicuous white rump and rufous tail. The under parts are velvety black. Female brown, bears a short tuft on crown and with a broad white throat. Inhabits temperate forest belt of pine, oak, and grassy slopes, in winter descends to lower forest valleys. Moves singly or in parties, usually quite shy, when alarmed flushes at a considerable distance and produces peculiar whistle in flight. In courtship cock spreads out its tail over the back and slightly jerks. Limited to the Himalayan range. Status—endangered, population becoming scarce in accessible areas on account of poaching.

6. **Blacknecked Crane.** ***Grus nigricollis*** **Przevalski**
Standing c. 152 cm.

A large elegant grey crane with long neck and legs, and a short tail. Distinguished from the Common Crane (*Grus grus*) by having entirely a black throat, neck and tail. Head black with bare dull red crown and lores. Inner secondaries long, black, drooping over tail. Feeds in paddy fields and marshy areas in winter, repairing at night on the banks of lonely jheels. It never perches. Vegetarian in diet but also probes in the soil with its bill to get larvae. Courtship display during breeding season (May-July), the male suddenly spreads its wings and lowers its head and leap into the air, trumpeting loudly. Breeds in Ladakh at c. 4200-4600m. A few small wintering flocks also recorded from eastern Bhutan at 2000m and above, Bhumthang, Gyesta and Tashi Yang-tsi valleys. So far no other records have been made within our limits. Rare. Presently wiped out completely in Apatani valley, Arunachal Pradesh by local inhabitants.

7 **Siberian Crane.** ***Grus leucogeranus*** **Pallas**
Standing c. 140 cm.

A snow-white graceful crane with a white long neck and pinkish long legs, wings long and broad, tail short. Face and forecrown with red bare skin, quills all black. Usually the wariest of all cranes. Moves in marshy areas in small parties in search of aquatic vegetative matter. Flies without stretched neck, head and feet. Generally makes a 'V' shaped line while migrates. Breeds in Southeast Russia, Siberia and Turkestan. In India arrives in winter (November-December). Reported to occur in Uttar Pradesh (Payagpur jheel) and the Keoladeo Ghana sanctuary in Bharatpur in Rajasthan. Greatly endangered. The total world population at present estimated to be some 190.

8. **Great Indian Bustard.** ***Ardeotis nigriceps*** **(Vigors)**
Length c. 122 cm. Standing height over a metre to top of head.

A large heavy ground bird with a long neck and stout bare legs. Plumage pale buff, finely pencilled with black and white below, crown black and crested, neck broad, white with a black breast band. Female smaller and lacks the breast band. Inhabits wide open desert and semi-desert country. Normally found singly also in scattered parties of 5 or 6, or in pairs, runs at great speed on scenting danger. Omnivorous, food comprises arthropods, lizards, grass seeds, oil seeds and cultivated grains. Male keeps a harem. Breeding season principally between March and September. Nests on the ground. Female only incubates. Endemic in Pakistan and India. About 100 years ago stated to be common and widely distributed from the Indus river to Bengal and in south up to Tamil Nadu; now restricted to remote areas of Rajasthan, Gujarat and Karnataka. Present status rare, except in protected areas. Estimated number of the bird in Rajasthan which is the real home of Great Indian Bustard is about 1200. After Indian independence, habitat destruction and wanton killing have affected the life of this large elegant bird.

9. **Bengal Florican.** ***Eupodotis bengalensis*** **(Gmelin)**
Length c. 66 cm.; standing 55 cm. to top of head.

A terrestrial bird with stout bare legs, diagnostic white rounded wings and a short tail. Male black, moppy crested with mottled

brown back and white winged. Female large, overall rufous-buff and brown without a crest. Inhabits tall grassy patches. Moves through grassland singly or in scattered flocks in non-breeding season but in breeding season form small parties consisting of four to eight birds of both the sexes. Active at dawn and dusk; a skulker difficult to locate unless takes to wings; flight strong and straight, suddenly disappears in grass far away from intruders. Omnivorous. During courtship the cock attracts the attention of the female by leaping high in the air repeating the act at intervals. No nest made; eggs laid on the ground; female only incubates. In India it occurs throughout the Brahmaputra valley and Duars of Assam and Arunachal Pradesh, Duars and Terai of West Bengal, Nepal, West Yamuna in Uttar Pradesh, Bangladesh. Present status endangered. About 50 years ago occurred in northern Bihar, at present no authentic report available from Bihar; reported fairly common in Nadia district of West Bengal in 1884, since then no record made. About a century back it existed in Bangladesh. Infrequently found in small numbers in protected sanctuaries on either side of the Brahmaputra valley. It is also found in small numbers in Nepal Terai and along the Indian Terai from western Uttar Pradesh to Bengal. Estimated population in Assam now about 300.

10. **Lesser Florican.** ***Sypheotides indica*** **(J.F. Miller)**
Length c. 46 cm.

A small, long-legged bustard, sandy buff, above marked with blackish narrow head in winter, in breeding period plumage turns pied with graceful curved peculiar plumes behind the ears. Female like wintering male but without plumes. Very similar in appearance to the Bengal Florican *(Eupodotis bengalensis)* but lacking the crest.

Found singly in grassy plains and possessing a curious habit of jumping into the air above the grass to attract the female prior to mating. Feeds on arthropods and vegetable matter. No nest made, eggs are deposited on bare ground. Only the hen incubates and rears the young. Resident species. Confined to the Indian subregion. Occurs throughout India except the humid areas. Status rare, due to destruction of its habitats by man and hunting for flesh.

11. **Jerdon's Courser.** ***Cursorius bitorquatus*** **(Blyth)**
Length c. 27 cm.

A compact little brown bird with chestnut breast contrasting with two traverse white bands. Crown and hindneck dark brown; supercilium long, white; legs long and pale yellowish-white; tail black and white. Inhabits dry deciduous bush jungles spread over the rocky ground. Found singly, sometimes in pairs or in small parties, when alarmed takes shelter under bush or takes to wings. Reported to lay a pair of eggs on bare ground.

It was believed to be extinct but again reported from Cuddapah district in Andhra Pradesh in January 1986. Endemic species in India. Occupies the Pennar and Godavari valleys in Andhra Pradesh.

12. **Indian Pied Hornbill.** ***Anthracoceros malabaricus*** **(Gmelin)**
Length c. 89 cm.

A black and white noisy hornbill with an enormous bill surmounted by a hollow horny yellow casque, with a frontal black patch. Neck black throughout. Outer tail-feathers black, tipped with white. Female smaller with different colour pattern on its bill. Inhabits in moist deciduous and evergreen forests. Found in small troupe in upper half of fruit trees. Long and graduated tail hangs straight down when bird rests on a branch. Flight slow, strong wingbeats with glides. Food comprises fruits and small creatures. Call a piercing '**kak-kak**' heard from a great distance. Nests in holes and hollows in large trees where female lodges to incubate. Both the partners rear the young. Resident and local migratory species, covering the Himalayan foothills from Punjab, east to Bhutan, northeastern states of India, West Bengal, Bihar, Orissa, eastern Madhya Pradesh, Andhra Pradesh and Bangladesh. Random hunting by tribal people for feathers, oil and flesh and deforestation resulting non-availability of suitable nesting trees appear to be reasons for their dwindling population.

Chapter 9

SOME ASPECTS OF BIRD WATCHING

There is no single method available which will encompass recording of the diverse observations required for bird studies in the field. Much depends on the observer to formulate his own technique with ample scope of incorporating further modifications when any new species is tackled or even when the aspect of study is changed. However, there are some basic common factors which can be generalized and those are considered here.

A number of questions will have to be answered before one sets out for bird watching. Where should one to locate the birds? What are their favourite sites? When is one sure to get them? What season is most rewarding? Which feeding sites do they prefer? Where do they nest? How do they nourish their young ones? What is their family life like and how do they behave with their fellow-members? Here an attempt has been made to explain some of these aspects of bird watching.

Watching birds in their natural habitats requires considerable patience. The best time for bird watching is early morning hours. The activity of birds begins much before the day break and reaches its peak just before the sun rises. The great volume of bird-songs which begins early in the morning is called Dawn Chorus. It will be an interesting thing for a bird watcher to be at the site when it is still dark and note the succession of the rising of the birds which can be marked by their songs. Birds can easily be sighted and traced in the dense vegetation as well once their calls are familiar to the watcher. Each species has almost specific time to begin its day. The songs and call notes can be recorded on a tape recorder and thus details of data can be registered at leisure.

Birds again become very active in their songs and notes at dusk; or the dim light of the evening. Certain species are at the peak of their activities in the evenings and are called crepuscular, the Nightjars (Caprimulgidae) are the best examples. Some birds are nocturnal, the Owls are outstanding examples of this type of birds. These birds feed at nights. The wild fowls (Anatidae) are partly

nocturnal, frequently feeding at night particularly during full moon periods. Thus, the best time for bird watching may appear to be varying with the species of birds selected for the study but for a general observer and the beginner morning hours prove unexceptionally interesting.

The best season for bird watching is just after the rains. This is the time when most of the insect fauna is available for insectivorous birds. Birds are attracted to the winged termite populations when they emerge for their nuptial flight. In forests birds show considerable preference for the trees with ripe fruits. Trees like pipal, banyan and fig attract birds on a large scale. Trees and bushes with attractive bright coloured flowers and flowers with nectar draw the attention of birds which feed on them. The ripe fruits and insects harbouring in the crevices of tree bark provide a big temptation for birds to stay on. Amongst the bushes which hold colourful blossoms as *Butea* species; amongst trees bearing berries and the figs, the mango, guava and such fruits with pulp, invariably attract the birds in different seasons. In these places a variety of birds can be located.

In forests, birds can be seen gathering at a particular place in a season where abundant insects and grasses are available. These places are generally found where mixed hunting parties of birds usually feed in a commensal activity. The insects disturbed by the activity and movement of one bird can become the prey of another. Such mixed hunting parties are common in many forests, and the association of a variety of birds can be termed as the Localized Forest Association.

Many of the bird species are peculiar in forming their own large or small groups, in which they live in association with a number of individuals. This type of positive social behaviour of formation of groups is known as *Flocking*. Sea birds in particular are gregarious throughout the year. Large flocks of these birds like Finches and Buntings can be seen in winter following their breeding season. The members of the each flock are mainly of a particular species and in this way they differ from the Localized Associated Birds.

Another important site which attracts a large number of birds available in the vicinity is afforded by water bodies. The birds usually occur in the vegetation near water masses, lakes and river

sides. Water is very essential for all birds, for drinking as well as for bathing. Bathing is essential for birds to clean and maintain their feathers. Virtually all birds bathe though not in the same way. Pheasant and Grouse only have dust-bath. Generally birds bathe in shallow water, bending down the neck and dipping it in water followed by lowering down of body and tail and then raising the neck for sending down the water over the body. The wings are fluttered to clean them. In the other types, loosely held wings are vigorously beaten against the water and splashing the water over plumage.

Semi-aquatic birds bathe while standing in shallow water. Most of the birds stay in water during bath but some land-birds move in and out of water. Aerial birds such as swallows, swifts, etc. bathe from the air, dropping repeatedly into the water for a short period. Familiar birds like pigeons, crows, sparrows, mynas, etc. also bathe wherever water is available for the purpose. Various actions of the bathing can be recorded when birds are being watched.

Act of drinking water also varies in different species of birds. Most birds fill their beaks with water and raise the head repeatedly to swallow water. Some imbibe water without raising the head and continuously drink or suck water till enough quantity is taken in. The aerial birds drink water in their flight as they pass over the water bodies by touching the surface.

After the bath, birds usually clean and arrange their plumage with the bill, often employing oil from the preen gland. Many birds spend much time on preening. The bill is used to draw the feathers through the mandibles. Preening is also done after dusting, sunning and anting.

Certain species like gulls, ducks and cranes spend much of their time standing either dozing or preening preferably near water bodies. This behaviour is known as loafing and the areas in which they occur regularly are known as loafing areas. These areas provide good site for a bird watcher.

Birds build their nests at a variety of places and they are of innumerable types. Major sites where bird nests can be located are in simple scraps on the ground covered with grasses and leaves. Nests on twigs are lined with soft material like grass, feathers, hay, etc. Nests can be often seen in tree-holes in decaying wood, in the bark of the tree or in the holes made suitable for nesting. Bird nests

can be located in excavated tunnels in earth banks or they are purposely built of mud. Some birds stitch leaves together whereas others make firmly woven and hanging nests from tree twigs and branches. Cuckoos build cup-shaped nests of grass.

Display : Birds through their movements and postures communicate with other members of their species or even with other species and animal groups. The bird-displays are mainly aimed at threatening when encountered with rivals; to show submission to the rivals of the mates, and accept the dominance; greeting the mates of opposite sexes at the nest and to scare away the predator from the eggs or young ones.

Courtship : This involves a variety of actions of birds by which they attract the mate and maintain the pair bond. The courtship in birds is the most interesting phenomenon to be observed. Display of a particular part of the plumage and offerings of a special type of food or flowering twigs and weed-exchange ceremony, construction of nests of the choice of the other sex and singing. Many more interesting activities can be observed at times only by sitting in concealment.

Breeding Behaviour : Many of the birds construct their nests jointly with the help of their partners. Both the male and female take part in constructing it. In others, house-building is the responsibility of a particular sex, either male or female. On acceptance of the nest of choice, birds usually copulate at the site or away from the nest. The eggs are laid in the nest and the number of eggs vary from species to species. A complete set of eggs laid by a female in one breeding attempt is known as clutch and many species lay more than one clutch in a season. All the eggs in the clutch may not be laid at one time and the interval may vary from few minutes to hours or days.

The young birds break the egg with an egg-tooth which they have on the beak and this hard calcareous growth is shed out within a few days after hatching.

A group of young ones of several pairs, particularly in migratory birds is known as a creche. However, the nestlings in the nest depend on their parents for food. Activities of birds while bringing up their offsprings are multifold and can provide many interesting observations to a bird watcher. Many birds have brood patch or

patches. This is an area on the underside of the adult bird where the feathers are shed. Brood pouches are richly supplied with blood and the skin there becomes swollen at the incubation time. Adult birds sit on their eggs, the act of Brooding, to keep them warm and activate the growth of the embryo. Brooding timings and periods vary from species to species and also the involvement of males and females in the family. Brooding also serves the purpose of protecting the eggs from predators. Aggressive behaviour of birds also can be closely observed when they are busy tending their young ones. However, threatening behaviour in birds may rarely result in physical assaults. Birds otherwise docile may be much aggressive when they are busy in parental care as can be seen in the Robin. More interesting behaviour can be seen in the case of the Cuckoo, it invades the nests of the Sparrow and allied birds and pushes out the nestlings and other unhatched eggs and completely encroaches the nest.

Parent birds feed their young ones by regurgitating half digested food in their beaks or feed them on tender food. The response of the chicks and nestlings on arrival of their parents, the greeting calls and the reactions of the adults to the demand of food by the number of fledglings are all the things to be watched, enjoyed and recorded by the bird watcher. In case of pigeons (Columbidae), the nestlings are fed during the first few days after hatching on a secretion produced in the adult crop. It is similar in composition to mammalian milk, being very rich in proteins and fats. This is called the Pigeon's milk. Many birds regurgitate the undigested food as well. This is usually passed out in the form of pellet. This is also known as casting. The birds can be seen ejecting the pellet and immediate search proves fruitful for its collection. Contents of the pellet indicate the dietary habits of the birds and their food. The analysis of pellet can be done with soaking it in water in a dish and then slowly disseminating the contents with forceps or needles. Usually pellets of birds of prey contain undigested bones.

Several birds have special calls of distress. These are used to make the other fellow birds aware of the arrival of predators, sighting a danger or undesired situation. With various types of sounds, the birds communicate with another. The calls from the parent birds are of great importance to the nidicolous (staying in nests) birds if they happen to be displaced and, to warn the fledglings of

the predators in nidifugous (leaving nest soon after hatching) birds to gather at a safer place.

It may not be necessary always for a bird lover to be on the move for bird watching. Some simple devices fixed on the house-roofs, canopies, trees, bushes and gardens can attract a variety of birds in the locality. These devices are less expensive and need negligible maintenance cost. Various types of feeding boards, water pans, feeding trays and bird baths with appropriate food like grains and fruits can attract birds. Availability of food and water at these spots makes the birds regular visitors. Birds thus can become bold enough to provide the viewer a closer look.

In case of migratory birds and visitor-birds, the bird watcher has to keep the record of their first sight, mentioning the date, time, place and the duration of their occurrence. With co-ordinated studies by several bird watchers, the isochronous lines for a species over large geographical areas can be drawn. These observations help the studies on migratory birds and to determine their routes.

A little hard work with a number of bird-guides, available these days, which provide near natural colour photographs of birds and their description and names, can enable the interested bird watchers to identify a number of birds with some accuracy. More and more bird-watching adds to the experience and some training through the expert hands invokes a lot of confidence in amateurs. A bird watcher when trained, can easily identify at least the more frequently occurring species by their calls, a mere sight when they are in flight or observations from a distance through powerful binoculars.

When more serious and extensive or intensive studies in birds are undertaken, the birds are caught in the mist net, which is made of strong fine nylon wires and are fixed at various sites in the field. The birds get entangled in these invisible nets. They are then removed carefully. All relevant data pertaining to studies undertaken like the weight, length of various parts, ectoparasites, body colours, etc., are recorded and then the birds are ringed. The ringing involves fixing up a metallic ring on the leg of the bird, which bears the serial numbers, name of surveying institution, date and place where they are caught and released. The rings are of various sizes and usually birds get used to them. Such ringed birds when

caught again or killed must be returned to the surveyor with mention of date and place where they were found. Such large scale surveys have yielded rich information particularly on migratory birds which travel thousands of miles in each breeding season through fixed routes.

At night, birds are watched in relation to the position of the moon. The moon is taken as a background clock and position of the migratory birds in terms of hours is located.

The bird watcher when out for bird watching, should carry with him the binoculars, a field note book, pencil and the map of the area under observation. It is often useful to have a consolidated list of birds available in the locality which makes the job easier. Careful observations on the size, colour pattern, mode of flight, the songs and other behavioural patterns as discussed above prove much useful in identifying the birds. It is advisable to visit the museums to study the stuffed and named bird collections.

Chapter 10

BIRDS AS FRIENDS AND FOES

With the advancement of science and technology, communication between distant places had become now a matter of fraction of a second. In the past, several methods were used to convey messages from place to place like the use of signals, runners, fire torches and so on. In addition to these, right from ancient times trained birds were used for carrying messages between distant places. Messenger pigeons were used till very recent times, as in the World War II, which worked very efficiently.

A number of birds are used for sports. Trained cocks and hens are used for competitive fights which entertain a number of people who even bet on the winner. Falconry is another interesting game popular in many countries.

Birds contribute indirectly to human welfare as majority of them feed on insects and rodents and few others are efficient scavengers. They act as pollinators. Poultry farming is a leading profession which provides nutritive food products for human consumption.

However birds are responsible to act as vectors of a number of diseases. They prove hazardous when they collide with aircraft. This portion describes in details the role played by birds as friends and foes of human society.

Birds are intimately associated with human society in various ways. Apparently it may be seen that most of the birds are either indifferent or are economically hazardous to human society, since many of them have grains and fruits as their principal food. But if the role played by the birds in nature is considered from various direct and indirect involvements of the bird community in general, with human welfare, it can be seen that birds do account considerably for the beneficial side as well. The common man may not be aware of these useful activities of birds as much as he is aware of the insects as pollinators and their products like honey and silk.

A close look at the biology, behaviour and food habits of birds will enlighten the interested person to realize the magnitude of impact the birds have on human interests. Some of the important and major aspects of the role, birds play are discussed below.

The birds feed on variety of items. The insects and worms are one of the major constituents of bird food, besides grains and other vegetable matter. One would be surprised to know, for example, that many young birds, in their early developmental period, daily consume more than their body weight and the major portion of their food usually contains young and soft bodied insects. Locusts and grasshoppers, crickets, bugs, dragonflies, beetles and many other insect groups form substantial amount of food for birds. The birds thus act as natural biological control agents for many of the insect pests. They not only consume young and adult insects but also dig out their eggs and devour them as in the case of locusts and prevent prolific breeding of these harmful pests.

A sizable group of birds of prey such as Owls, Kestrels, Hawks, have their principal food as rats and mice. Mice in the fields and forests are usually hunted and eaten by these birds. The gut contents of birds like Horned Owls, for example, have shown remnants of two or three mice at a time. This fact can help estimate the voracity of these birds, on mice which are notorious pest of a variety of cash crops.

Yet another activity of birds related to their food habit is the role they play as scavengers. Vultures, kites and crows are indispensable scavengers. They efficiently dispose off the remnants of dead animals, left over in the villages, where there is no systematic disposal of these carcasses and refuge. Usually bodies of dead animals like cats, dogs, and other live stock are thrown out in the open and left unattended to. Birds help in a great way for their quick disposal.

Birds have been gifted with very powerful vision which, being provided with high degree of adaptive mechanism, which helps them in finding prey and locating their feeding sites from unbelievable distances.

Birds act as effective pollinators. They nest in trees and can reach far off distances which may be inaccessible to other flying agents like insects such as butterflies. The nectar sucking birds are

specially adapted with pointed and long beaks and narrow foreheads which enable them to collect honey by deep penetration. While trying to reach to the nectar, birds unknowingly act as cross pollinating agents. The love and attraction towards shiny and colourful blossoms of trees, bushes and creepers in forests make the birds engaged in this activity considerably.

Birds enjoy a special position in forest ecosystems, through their nesting habits, feeding habits and other activities. Birds, like wood peckers reduce the thickness of the bark which may provide sites for proliferation of harmful insects. Sealing of the bark of big trees is the activity of certain birds which keeps them busy for long periods. Thus flaking off of the bark exposes the insect pests and alters their microclimatic conditions which in turn affect the survival of immature insects and thus involve an indirect control of insect pests.

The invaluable service rendered by the birds to human society is their use as food. The poultry industry sacrificing the innocent lives of innumerable cocks, hens and ducks can only be imagined in the context of their consumption through out the world. Raising of hybrid strains of hens and producing unfertilized vegetarian eggs are the two major landmarks in the vast development of poultry industry that have exploited birds to a maximum extent.

The most important but economically insignificant virtue the bird community possesses is the aesthetic sense it endows to the human race. Presence of birds is not only a sign of the healthy atmosphere but it is much appreciated by every one. This has gone to the extent that in many communities, countries and religions birds are being worshipped as the sign of sanctity, purity, peace and prosperity. Some birds can be trained to certain extent since they can learn and retain instructions. Successful use of pigeon species was made in ancient times to carry messages from place to place. Birds like Parrots and Kakatua are kept as pets and can imitate human voices to a limited word-groups and can provide much entertainment.

However, the entire bird community should not be mistaken to possess only useful characters. Birds do account for losses in terms of economy in human interests.

The most important of these losses are the ones caused to cash crops such as various grains and fruits. Most of the birds feed on grains right from the stage of their milkiness in the field. A large number of bird (usually in high populations) feed on grains and spikes in the fields. Farmers from all over the country remain busy and worried to save their crops from birds, which usually feed during dusk and dawn. There has not been a single method useful in scaring the birds away from crops. The greatest difficulty in correctly assessing these losses is that birds are visiting feeders. They reside on tree tops and their mobility, with high-speed flights makes it difficult to formulate any data on actual census. Moreover, how much a single bird has consumed during each feeding is almost impossible to assess in the fields. Therefore, all the estimates made on the losses of crops by bird-feeding are only speculations. Nevertheless it is said that heavy loss nearing 20% to 40% occurs due to bird-feeding on grains.

Birds in forests peck and make holes in the bark of trees and make the spread of certain pests specially fungal diseases, thus accounting for the loss of the healthy logs. The entry of the wood boring beetles is made easy owing to scrapping off of the barks by birds like woodpeckers.

Birds can prove hazardous to human health as they take part in harbouring parasitic pathogens either externally or internally. The birds drop their excreta from air when they are in flight and thus contaminate the products for human consumption. Contamination of food, pharmaceutical items and hotel beverages, in large and tall buildings are the usual places of occurrence. Diseases transmitted by birds are known as Ornithosis. Some diseases spread by birds are as follows:

1. ***Psittacosis*** : This causes respiratory ailments in humans. The disease is caused by common birds like parrots, pigeons and sparrows. In certain countries special programmes are launched for control of the population of these birds..

2. ***Histoplasmosis*** : This is a fungus-borne disease caused by *Histoplasma capsulatum* which grows on bird droppings which decay. This disease causes lesions in lungs, spleen and liver in many animals.

3. ***Avian Pox*** : This pox is reported in many birds and domestic chickens. The infection is seen to spread in throat and nasal passages of these birds.

4. ***Encephalomyelitis*** : The birds carry this virus which is spread to humans through ectoparasites like mosquitoes and ticks. Birds are known to harbour encephalitis carrier *Haemophysalis sp.* and *H. spnigera* ticks.

5. ***Salmonellosis*** : This disease is spread among humans and cattle and other live stock through bird droppings.

6. Many parasitic pathogens like *Schistosome* larvae are passed through bird droppings. Birds have lice, ticks, mites and other vectors on their bodies or in their nests which take indirect part in spreading of a variety of diseases.

Bird collisions not only involve economic losses but also the lives of a number of people. The airports are large areas adjacent to crowded cities. These are protected areas with limited human activity therefore they are favourite sites for variety of birds to harbour. The aircraft when run in high speed have to face a tremendous impact when a bird hits. The velocity of the aircraft causes shattering of its planes and frames due to the intensity of the collision. At times large birds are sucked in through the jet engines with the result that the bones, feathers and muscles make the engine function-less which leads to accidents or forced landings. The collision at times takes heavy toll of lives and usually disturbs the schedules resulting in heavy economic loss besides the amount spent on repairing the air crafts. This problem of bird-strikes has been realized by the airport authorities and at certain ports a massive programme for driving or scaring the birds away from the vicinity has been seriously launched. The magnitude of the problem of bird-strikes can be realized if the total number of bird-strikes, since 1976 to 1981, are seen, to stand around 382 only at eleven airports like Agra, Srinagar, Jammu, Hyderabad, Trivandrum, Patna, Guwahati, Bombay, Calcutta, Delhi, and Madras. The approximate cost of repairs during 1978 to 1981 reaches to 297 lakhs of rupees while estimated revenue losses owing to these bird-hits amount to Rupees 19 crores.

With considerations on the points mentioned above, it can be seen that birds, like any other animal group play both beneficial

and harmful roles to human society. Proper management of bird population, control methods on their feeding, and other hazards like bird-hits can be reduced to a considerable extent which will help to execute the birds their right to existence on the earth.

Chapter 11

COLLECTION AND PRESERVATION OF BIRDS

In nature study, birds are best observed through good binoculars and shot with a camera not with a gun. These days killing of several species of wild animals and birds is strictly prohibited. However, species of common occurrence whose killing is not prohibited by law, can be killed for detailed studies. Under such circumstances, when it is essential to kill a bird for study, a basic knowledge of taxidermy is a must for an ornithologist. Often many valuable skins are damaged due to the lack of knowledge of taxidermy, thus making their study difficult. In the following pages, taxidermy procedures are given in brief, from collection and preparation of study skins to mounted specimens.

COLLECTION

Usually firearms are used for killing birds for study. The firearms with different bores are used according to the size of the bird and its shooting distance. The larger bore gun is used for larger specimens and/or from long range, and the smaller bore gun for smaller specimens and/or from close range. A gun with 12- or 16-bore and a .410-bore shotgun, and cartridges nos. 3 or 4 and 8 or 9 are most suitable for killing a bird. Besides these firearms, various types of traps and nets are also used for collecting birds. To undertake any collection trip the following items are most essentially required in the field :

1. Absorbent cotton-wool : this must be of a very good quality with long fibres ; 2. Old newspapers for carrying dead birds and wrapping dry skins ; 3. A pair of dissecting scissors with 6 cm long blade ; 4. An ordinary knife or kitchen knife ; 5. A pair of small dissecting forceps about 12 cm long ; 6. A pair of long forceps about 25 cm long ; 7 A sable hair No.8 artist brush ; 8. A scalpel with about 4 cm long blade ; 9. A pair of

---

Article by Dr. J.K. Sen and Shri D.N. Basu, Zoological Survey of India

bone cutters and cutting pliers ; 10. Sewing needles nos. 2-8 ; 11 Cotton thread ; 12. Field note book ; 13. Chloroform ; 14. Formalin (40% solution) ; 15. Rectified spirit ; 16. Common salt ; 17 Arsenic soap ; 18. Galvanized iron wire of 11, 16 or 18, 20 or 22 gauges and wooden or bamboo sticks of various lengths and 19. Kit bag.

Immediately after collecting the bird, blood stains should be removed with wet cotton. Dry blood stains are difficult to remove. Plug the mouth and cloaca with cotton-wool. If the body has deep holes (injury) they are to be plugged with cotton-wool.

SKINNING

Before starting the skinning of a bird, it is advisable to take measurements of its beak, wing, tarsus, tail, etc., (Fig. 15, a-d). This will be of great help in identifying the bird. Afterwards place the bird on a clean table with the ventral side upwards. Make a small incision with a scalpel, the incision on the skin should begin from the hinder end of breast and extend up to mid abdomen. The size of incision will depend on the size of the bird, but smaller the incision better it is (Fig. 15, e). Care should be taken not to puncture the abdomen. Now with the help of scalpel and fingers the skin should be detached from the body (Fig. 15, f), slowly and carefully, till the whole abdominal as well as breast area are exposed. The leg bones at the femur-tibia joint (knee) are cut with the help of a pair of bone cutters (Fig. 15, g) and detached from the body.

Similarly the body at tail end is also detached by cutting at the root of the tail. With the help of fingers the skin of the dorsal side is separated from the body and the wing bones are cut off from the body at the shoulders (Fig. 16, a). Now holding the body, the skin is slowly turned inside out (Fig. 16. d) till we reach the skull. Pull skin out of earholes with fingernails or forceps, cut thin transparent membrane which attaches eyelids to eyeballs, care is taken not to damage the eyelids. Remove the eyeballs and remove the floor of the mouth-cavity, including the tongue. The brain is thoroughly scooped out of the skull as much as possible.

STUDY SKIN

The preparation of study skin is essential for the Ornithologist for taxonomic studies. The technique of preparation of study skin of a bird is different from that of its mounting. When the skin is completely inside out, cut off the upper arm bone just short of elbow-joint and remove it along with flesh. Remove all the flesh from the leg bones and base of the tail, and from the skin as much as possible.

Apply arsenic soap all over the inner surface of skin and exposed parts of bones where traces of flesh might still be present. Make up leg muscles with cotton-wool wound around leg bones. Two small cotton-wool balls are placed in the eye sockets before reversing the skin over the skull. Skin of the head and eye-lids are adjusted by pushing through the gaps of eye sockets and eye-lids, gently moving around the entire socket rim. Cotton-wool balls are then slightly pulled outward with forceps so that the eyelids are stretched a little and dry evenly. Turn the head back to its normal position, but do not pull the skin of the neck. Tie the forearm bones of one side with those of the other side by passing a string through the loop formed by these bones at elbow-point. The skin of the neck of birds with large heads and narrow necks such as parrot, duck and wood-pecker can not be drawn over the head. In such cases, remove the skin of the neck as forward as can be easily done, then cut off the neck. Make an incision through the skin from middle or back of crown to neck (Fig. 16, b-d). Turn out skull through this opening. A smooth bamboo stick or a piece of galvanized wire with pointed end, about 1.5 times longer than the total length of the specimen, is required to prepare the study skin.

A conical shaped artificial body (Fig. 17, b) is made on it by rolling and tying waste jute or cotton-wool. The artificial body is then inserted into the skin and the pointed end of the stick or galvanized wire is directed straight through the skull towards the beak to ensure that it gets a strong hold (Fig. 17, e,f). Care is taken that it should not pierce through any of the skull bones or beak. The skin is adjusted over the artificial body after duly filling with cotton wool wherever it is required.

Now the incision is stitched up with needle and thread without trapping any feather in between.

To retain all the characteristics of the plumage, filling up with cotton-wool through the mouth, eyes and body while stitching the abdominal portion may be done. Other end of the stick or galvanized wire of the artificial body is placed on the middle of the tail feathers by stitching tail roots. As a result of this the tail feathers also remain strongly attached to the body. Then the wings and legs are placed in position. Feet are tied with thread cross-wise. Label is attached to feet. The whole plumage is gently tied by winding fine thread, to keep all the feathers in position till the plumage gets completely dried up.

MOUNTING

Before mounting, every trace of flesh, fat, fibre, membrane, if any on the inner side of the skin should be cleaned properly. Powder alum is applied thoroughly once again to obtain good results and increase durability of the skin. The wing bones are tied together leaving little gaps in between. Now the skin is ready for mounting.

While mounting, galvanized wires are used to support the bird for its anchoring and erecting. The size and length of these wires depend upon the size of the bird to be mounted. Three pieces of wires are required for one bird : one for the support of the body and two for the legs. All the three wires are pointed at one end. Two loops are made on the wire supporting the body. An egg shaped manikin body is artificially prepared on it with waste jute or with fine wood-wool according to the size of the actual bird (Fig. 17, a). It is wound up with a strong thread. The loops on he wire are made so as to keep the artificial body in position. The neck portion is built up on the same wire by winding absorbent cotton-wool and fine thread as per the actual length and thickness of the neck.

The artificial body is then inserted through the opening towards the neck and head (Fig. 17, e,f). The top end of the body wire is pushed up, piercing through the skull. The skin is then adjusted on the artificial body carefully, and the feathers are also adjusted and set in position. The lower end of the body

wire is anchored at the base of the tail. The legs (Figures 17, d) are wired by pushing through the bottom of the foot, which along with tibia-fibula is tied with a thread. There should be some protruding portions of the wire on both sides of the leg bones. Muscles are then replaced with cotton-wool, the protruding portion of the wire towards the body is locked with it either piercing or by looping. If necessary, empty space should be filled with absorbent cotton-wool to get the exact shape of the body. The skin is stitched where the incision was made.

The bird is then fastened to its perch on the wooden base or on the branch as desired, with the ends of the wire protruding at the bottom of feet (Fig. 17, c,d). The legs, neck and the tail are bent in their natural posture. The body (Fig. 18) is given shape according to its life-like appearance. The neck cavity is filled up with absorbent cotton through mouth.

Artificial eyes are socketed and adjusted through the eye lids as per the colour noted at the time of collecting the bird. A thin layer of varnish is brushed over the beak and legs to retain the colour. After a week or so the protruding part of the wire on top of head is cut off. Now the bird is ready for display.

LABELLING

Every Zoological specimen collected and preserved for scientific study should have a label indicating its scientific and local name, place of collection (locality, district, state and country), name of the collector, date of collection, name of the museum/institution on one side. On the reverse side of the label additional data on body weight, size of parts of the body (beak, wing, tail and tarsus), colour of soft parts (iris, beak, face and claws) and condition of gonads may be written. All entries of the label should be made with waterproof black Indian Ink. The data labels are written on a strong, durable cartridge paper approximately 7x2 cm in dimensions, with a cotton string attached at one end. Sample label is shown in Figure 19-a,b.

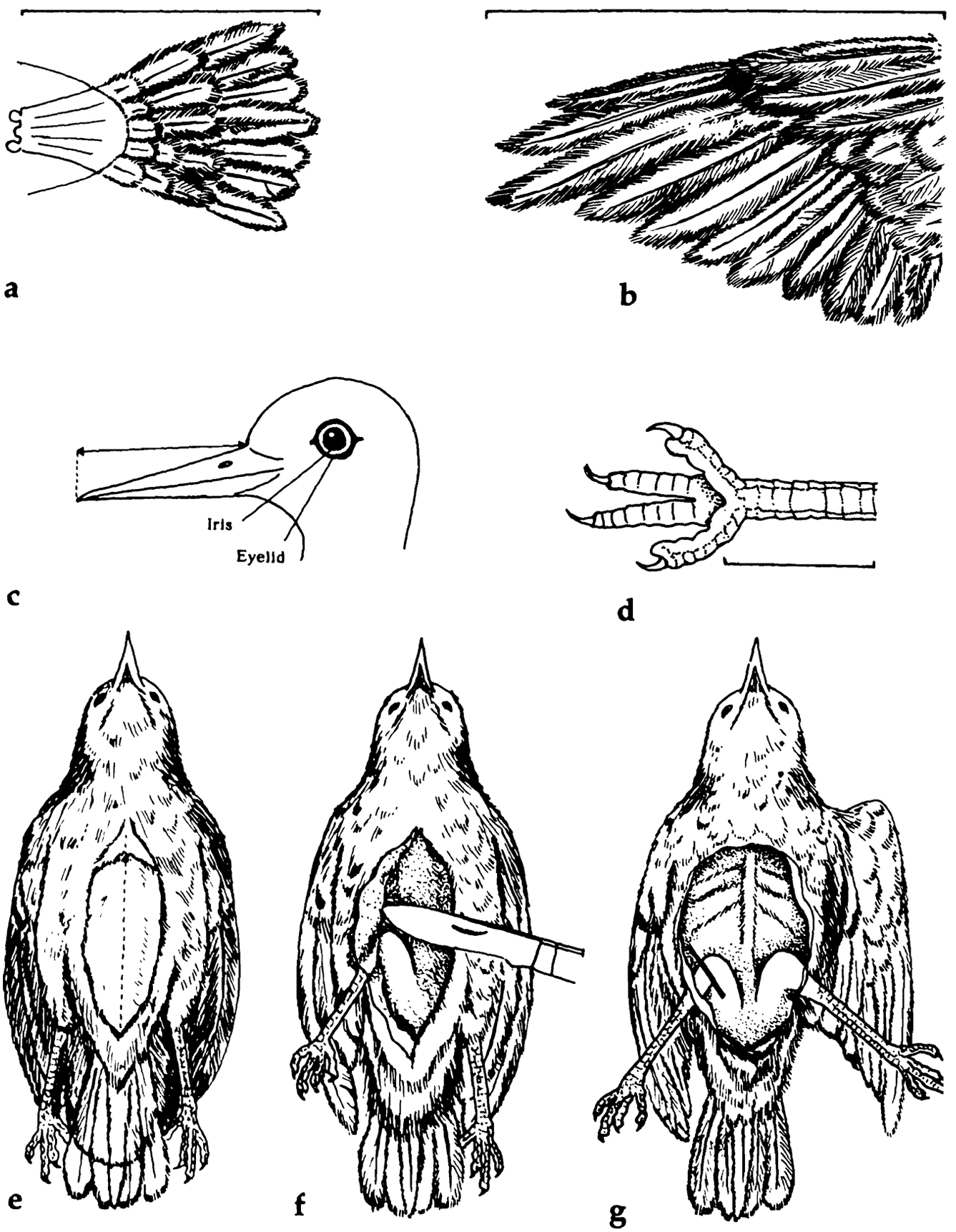


Figure 15 — a-g. Various stages of skinning : **a-d** — Body measurements ; **e, f** — making an incision and detaching of skin ; **g** — cutting of knee bone.

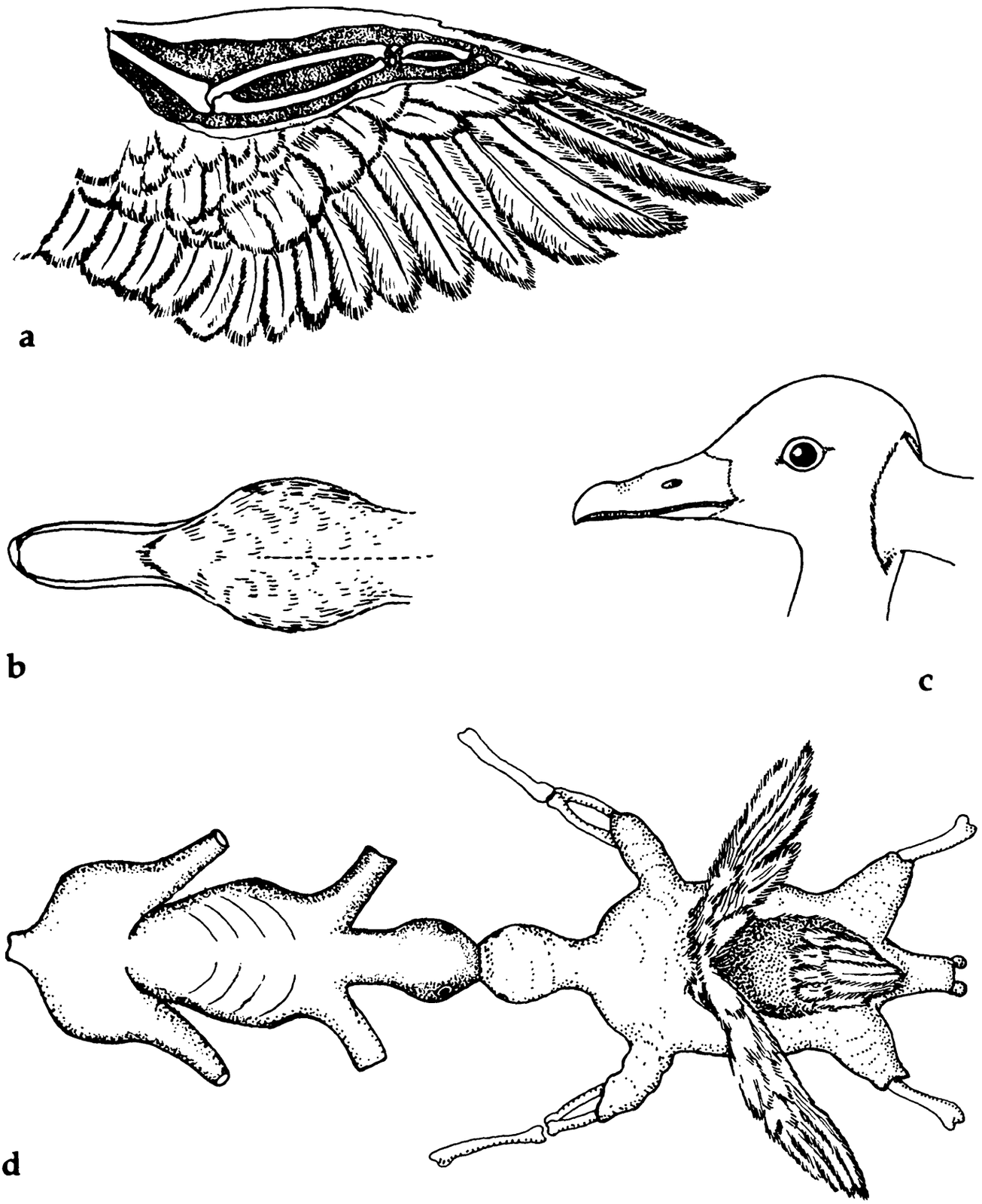


Figure 16 — a-d. Various stages of preparation of study skin: **a** — Cutting of wing bones ; **b, c** — making an incision at the back of crown or neck ; **d** — turning the skin inside out.

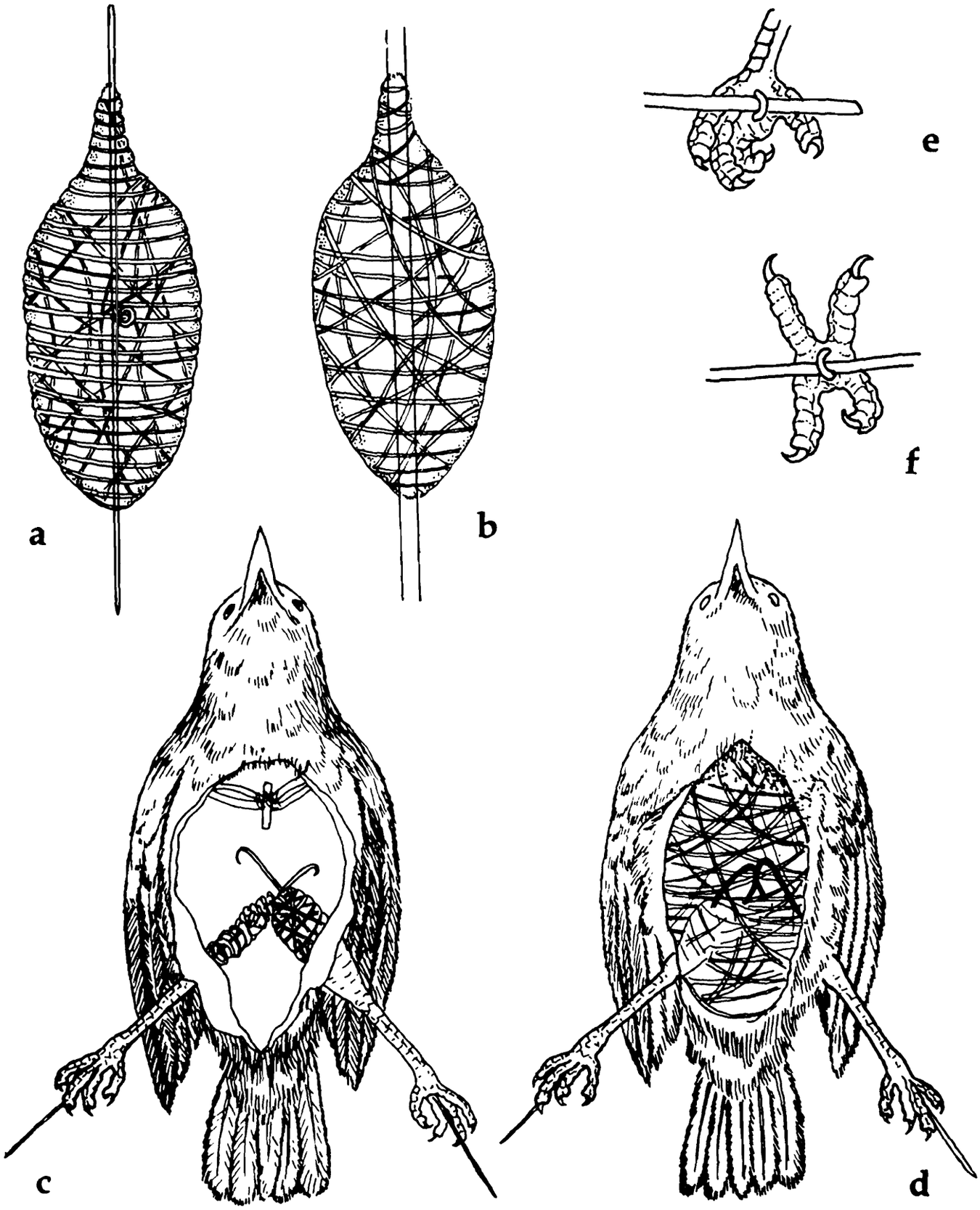
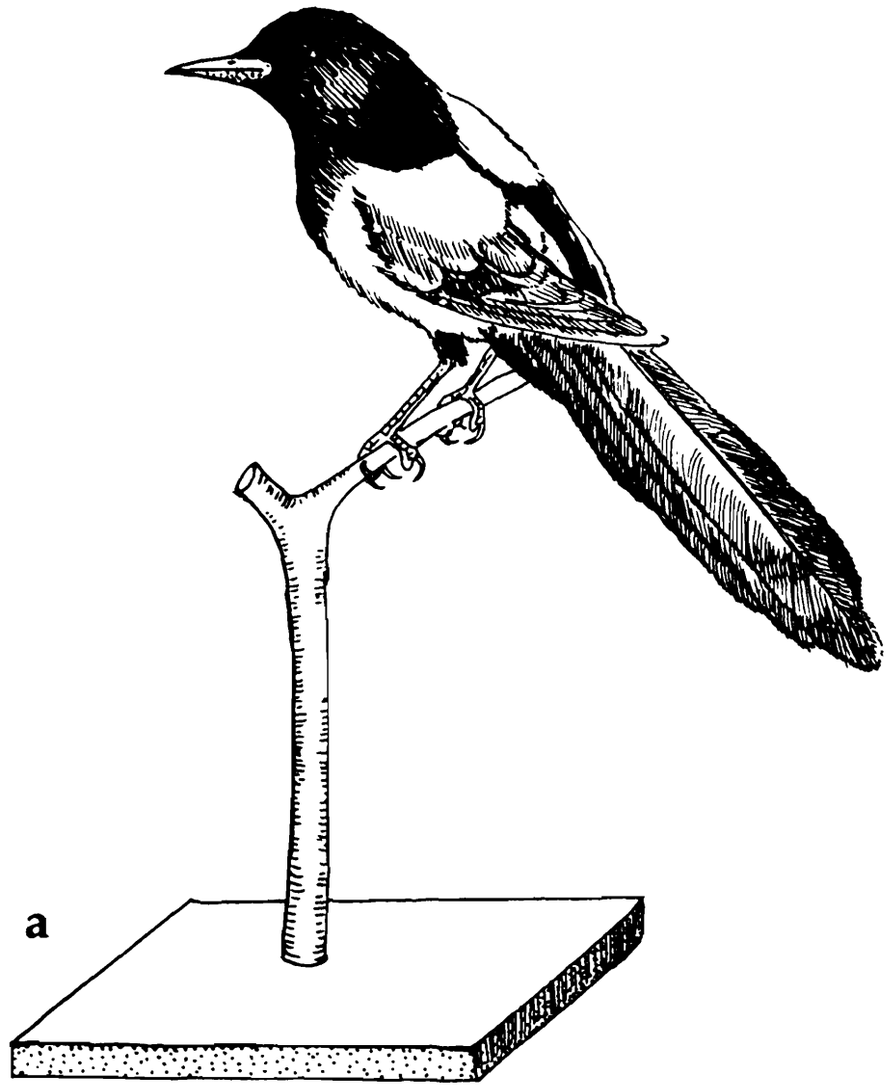
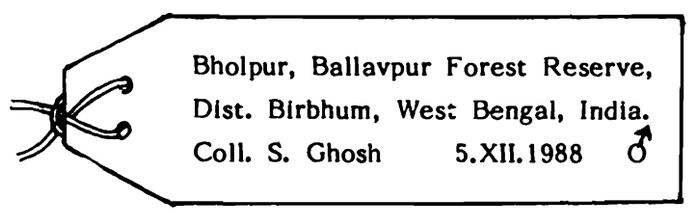


Figure 17 — a-f. Various stages of preparation of study skin and Mounting : **a, b** — Preparation of an artificial body ; **c, d** — artificial body inserted into the skin ; **e, f** — fastening the body to its perch.



a



b

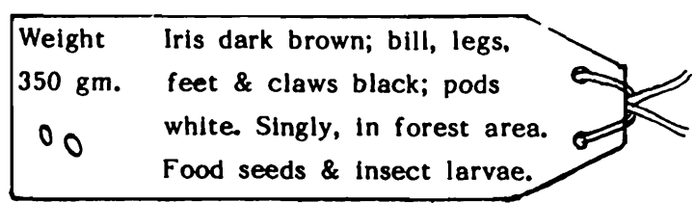


Figure 18 — a-b. **a** — Whole mounted specimen ; **b** — sample label showing data on both sides.

Chapter 12

SOME SUGGESTED READINGS

Ali, Salim and Ripley, S. Dillon (1968-74). *Handbook of the birds of India and Pakistan.* 10 vols. Oxford University Press, Bombay.

Ali, Salim (1972). *The book of Indian Birds.* Bombay Natural History Society, Bombay.

Alexander, W.B. (1955). *Birds of the Ocean.* Putnam, London.

Baker, E.C. Stuart (1922-31). *Fauna of British India.* Birds. 8 Vols., Taylor & Francis, London.

Baker E.C. Stuart (1908). *The Indian Ducks and their allies,* Bombay Natural History Society, Bombay.

Bates, R.S.P. and Lowther, E.H.N. (1952). *Breeding Birds of Kashmir.* Oxford University Press, Bombay.

Delacour, J. (1954-62). *The Waterfowl of the World.* 4 vols. Country Life, London.

Hawkins, R.E., (ed.) (1986). *Encyclopaedia of Indian Natural History.* Oxford University Press, Bombay.

Henry, G.M. (1971). *A Guide to the Birds of Ceylon.* Oxford University Press, Bombay.

Hume, A.O. and Marshal, C.H.T. (1878-80). *The Game Birds of India, Burmah and Ceylon.* 3 vols. published by the authors, Calcutta.

Hume, A.O. and Oates, E.W (1889-90). *Nests and Eggs of Indian Birds.* 3 vols., 2nd ed., R.H. Porter, London.

Jerdon, T.C. (1862-64). *The Birds of India.* 2 vols. (3 parts) Published by the author, Calcutta.

King, B., Woodcock, M. and Dickinson, E.C. (1986). *A Field Guide to the Birds of South-East Asia.* Collins, London.

Mukherjee, A.K. (1982). *Endangered Animals of India.* Zoological Survey of India, Calcutta.

Oates, E.W and Blanford, W T. (1889-98). *Fauna of British India,* Birds, 1st edition, 4 vols. [vols. 1 and 2, by E.W. Oates, 1889-90; vols. 3 and 4, by W.T. Blanford, 1895, 1898] Taylor & Francis, London.

Perrins, C. (1976). *Bird Life.*Elsevier International Project Ltd., Oxford.

Peters, J.L. (1931). *Check-list of the Birds of the World.* vols. 1-7, 9, 12, 15 published 1972. Museum of Comparative Zoology, Cambridge, Mass.

Rashid, Harouner (1967). *Systematic List of the Birds of East Pakistan.* The Asiatic Society of East Pakistan, Dacca.

Ripley, S. Dillon (1982). *A Synopsis of the Birds of India and Pakistan.* Bombay Natural History Society, Bombay.

Smythies, B.E. (1953). *The Birds of Burma.* Oliver & Boyd, Edinburgh.

Thompson, A.L. (1964). *A New Dictionary of Birds.* T. Nelson, London.

Tikader, B.K. (1983). *Threatened Animals of India,* Zoological Survey of India, Calcutta.

Tikader, B.K. (1984). *Birds of Andaman & Nicobar Islands,* Zoological Survey of India, Calcutta.

Van Tyne, J. and Berger, A.J. (1959). *Fundamentals of Ornithology.* John Wiley and Sons, New York.

Van Tyne, J. and Berger, A.J. (1978). *An Introduction to Ornithology.* John Wiley and Sons, New York.

Whistler, H. (1941). *Popular Handbook of Indian Birds.* 3 ed., Gunnery & Jackson, London.