



A Laboratory and Field Manual of  
**ORNITHOLOGY**

by OLIN SEWALL PETTINGILL, Jr.



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**ORNITHOLOGY**

by

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To

ALFRED O. GROSS

*Professor Emeritus of Biology at Bowdoin College  
preëminent ornithologist and inspiring teacher.*

## PREFACE

During the eighteen years since 1937, this manual has moved through four stages of development. In the first stage, the book was simply a series of typewritten outlines which served my students as directions for work in class, laboratory, and field. In the second stage, reached in 1939, the outlines were revised and issued in mimeoprint. The third stage came about because of the need of more detailed directions for study, supplemented by explanatory text. Thus in 1946 a second edition (in photo offset) was published. It contained eighteen sections; eight of these included explanatory text, as well as study directions. Seven appendices were added.

In the years following 1946 the manual was adopted by over a hundred colleges and universities in forty-two states. As the time approached to bring the manual up to date, I sent a questionnaire to instructors who had been using the manual regularly, asking what they would like to have incorporated in a new edition. There were a gratifying number of responses. Their many helpful suggestions and those of my students, together with new ideas of my own, developed the fourth stage -- the present edition.

The manual now has twenty sections. Two are mainly explanatory text and three mainly study directions; the others are about two-thirds explanatory text and one-third study directions. All the material of the preceding editions has been completely revised. Eighteen of the sections are followed by pertinent bibliographical references as a guide to further inquiry. There are still seven appendices, with contents little changed; all except one appendix (B) has been extensively revised. In the preparation of this edition a marked effort has been made (1) to extend the scope so that the manual can be used to equal advantage in any part of the United States or Canada, and (2) to give wider coverage of ornithological work in all parts of the world.

Like the earlier editions, this edition is intended as an aid to ornithological study at the college or university level. If a student lacks the background knowledge usually acquired by a course in general zoology or biology, he should keep for ready reference a standard text in general biology.

This work does not pretend to cover the ornithological field. It contains a selection of the more important aspects of ornithology that can be studied during a course in a semester or summer session of the academic year. There is much more subject matter than can be included in any one course; the instructor must choose his own particular topics. It is assumed that the instructor may wish to present still other aspects of ornithology (e.g., origin of birds, food and feeding habits, social behavior, relations of birds to man) which he thinks suited to the objectives of his course.

Besides explanatory text and directions for class study, the manual includes material to assist students in independent investigations: the rather detailed suggestions and the extensive references given at the end of nearly every section, as well as the several appendices, have been included especially for this purpose.

Since the sections of the manual are more or less independent units, sections may be taken up in any order and sections may be omitted. Owing to the fact that ornithology courses vary widely according to locality, time of year given, number of class hours per week, and emphasis or purpose, it is to be expected that each instructor will adapt the manual to his particular needs by selecting sections in the order which seems most logical to him.

In order to use the manual effectively, certain equipment and materials are necessary. The student should provide himself with:

- Binocular.
- Field guide.
- Key to the bird species found in the region where the study is being made.
- Daily field check-lists (as many as there will be field trips).
- Looseleaf pocket notebook, preferably with aluminum cover.
- A set of colored crayons.

The institution should make available to each student the following:

The American Ornithologists' Union "Check-List of North American Birds" (latest edition) and its supplements.

Annotated check-list of birds found in the region of the study.

An atlas of the world.

Telescope (preferably the so-called "spotting scope") with interchangeable eye-pieces and a tripod.

Compound microscope.

Meter stick.

A Common Pigeon and an English Sparrow, properly preserved but not plucked, for external study and dissection.

Pigeon skeleton, mounted.

Pigeon skeleton, completely disarticulated and mounted on a plaque.

Human skeleton, mounted; or a detailed chart of a human skeleton.

Human cervical vertebra (fifth).

Hyoid apparatus of a woodpecker.

A series of contour feathers illustrating specialized feather types.

(Some of the more exotic types may be obtained from zoos, which usually save such material for educational institutions.)

An adult down feather, a filoplume, and a section of the vane of a contour feather mounted on slides for microscopic study.

A series of wings and tails of a passerine species (e.g., the English Sparrow or the Starling) to illustrate the progress of molt.

A collection of bird skins representing all the orders and families of North American birds and all species found in the region of the study. (If possible, the collection should be sufficiently comprehensive to show sex, age, and other constant differences in plumage; abnormal plumage coloration; color phases; eclipse plumage; and plumage changes by wear and fading.) A transparent celluloid tube (capped) for each of the smaller skins that will be handled often is recommended in order to prevent damage. (These can be ordered from any biological supply company.)

A phonograph, with records of songs by species occurring regularly in the region of the study. (A list of records available can be obtained from the National Audubon Society, 1130 Fifth Avenue, New York 28, N. Y.)

In preparing certain sections of this manual I have naturally used numerous technical papers and books for basic information. The sources I have used most extensively are Rudyerd Boulton's "Ptilosis of the House Wren" (Auk, 1927); Elliott Coues' "Key to North American Birds" (1903); William H. Elder's "The Oil Gland of Birds" (Wilson Bulletin, 1954); R. M. Fisher's "How to Know and Predict the Weather" (1953); Denis L. Fox's "Animal Biochromes and Structural Colours" (1953); Volume 15 of "Traité de Zoologie" (1950) edited by Pierre-P. Grasse; Francis H. Herrick's "Wild Birds at Home" (1953); S. Charles Kendeigh's "The Rôle of Environment in the Life of Birds" and "Measurements of Bird Populations" (Ecological Monographs, 1934 and 1944, respectively); Ernst Mayr's "History of North American Bird Fauna" (Wilson Bulletin 1946); Ernst Mayr, E. Gorton Linsley, and Robert L. Usinger's "Methods and Principles of Systematic Zoology" (1953); Alden H. Miller's "An Analysis of the Distribution of the Birds of California" (1951); Margaret M. Nice's "Studies in the Life History of the Song Sparrow", Parts I and II (Transactions of the Linnaean Society of New York, 1937 and 1943, respectively), and "The Role of Territory in Bird Life" (American Midland Naturalist, 1941); Eugene P. Odum's "Fundamentals of Ecology" (1953); Robert Ridgway's "The Birds of North and Middle America" (1901-19); John H. Storer's "The Flight of Birds Analyzed through Slow-Motion Photography" (1948); Paul D. Sturkie's

"Avian Physiology" (1954); Gordon Lynn Walls' "The Vertebrate Eye and Its Adaptive Radiation" (1942); and John E. Weaver and Frederic E. Clements' "Plant Ecology" (1938).

The classification and nomenclature follow Alexander Wetmore's "A Revised Classification for the Birds of the World" (1951) and the A.O.U. "Check-list of North American Birds" (1931 edition, and its supplements to 1954).

The cover design is by Walter J. Breckenridge. All illustrations are also his, except: Plates I, II, III, V, VI, and XI (by William Mantagna); Plate IV, Figure 1 on Plate IX, Plates XII, XIII, XIV, XV, XVII, and XIX (by Ray S. Pierce); Plate XXII (by Alfred J. Hyslop); Plates VIII and XVIII and the map showing the pattern of weather fronts and wind directions (by Mrs. Helen S. Chapman); Plate VII (by Chapman, adapted from Jones, "Elements of Practical Aero-dynamics", John Wiley & Sons, Inc., 1942); Figures 1, 2, and 7 on Plate X (by Chapman, modified from Storer, "General Zoology", McGraw-Hill Book Co., 1943); Figures 3, 4, and 5 on Plate X (by Chapman, after Hyman, "Comparative Vertebrate Anatomy", University of Chicago Press, 1942); Figure 6 on Plate X (by Chapman, modified from Kingsley, "Outlines of Comparative Anatomy of Vertebrates", P. Blakiston's Son & Co., 1926); the cross section of a Blue Jay feather barb (by Chapman, modified from Gower, Auk, 1936); the map of major biotic communities of North America (by Frank A. Pitelka, American Midland Naturalist, 1941); the diagram of altitudinal succession of major biotic communities (Odum, modified from Woodbury, "Fundamentals of Ecology", W. B. Saunders Co., 1953); Plates XVI and XX and the two drawings of a passerine syrinx (Portmann, in *Traité de Zoologie*", edited by Grasse, Volume 15, Masson et Cie, 1950).

I wish to express my great indebtedness, not only to the several authors and publishers who have granted permission to use illustrations from their journals or books, but also to the numerous individuals who have helped me through all editions of this manual.

The following should be specially acknowledged for their help with those important parts of the second edition that have been retained: Frank C. Gates, for reading the section on bird communities; S. Charles Kendeigh, for reading the sections on bird ecology and bird populations; Mrs. Margaret M. Nice, for reading the sections on bird territory, mating, nests and nest-building, eggs, egg-laying, and incubation, young and their development, and parental care; Alfred J. Hyslop, for contributing the drawing of observation blinds; and Frank A. Pitelka, for allowing me to use his excellent map of the major biotic communities. In the stages that led to the development of the second edition, Arthur A. Allen and Alfred O. Gross provided many useful criticisms, and Mrs. Peggy Muirhead MacQueen and Miss Theodora Nelson gave much encouragement and willing assistance.

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Olin Sewall Pettingill, Jr.

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# TOPOGRAPHY

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The various regions of a bird's exterior are mapped out as the bird's topography. Knowledge of these topographical parts is indispensable in describing birds and serves as a basis for work in almost any phase of bird study. The beginning student should learn their names and significance at once.

For convenience in description the topographical parts are grouped below under seven titles: Head, Neck, Trunk, Bill, Wings, Tail, and Feet. As each part is studied, refer to specimens of both the Common Pigeon (*Columba livia*) and the English Sparrow (*Passer domesticus*) and to the outline drawings (Plates I-VI). Follow the instructions for labelling the drawings. Write all labels outside the drawings and parallel to the top of the page. Use dotted (i.e., broken) leader lines.

Begin by placing a pigeon specimen on its back and observing its outline or contour. The body shape tapers at both ends and is thus stream-lined for cleaving the air in flight.

## THE HEAD

The upper, or dorsal, part of the head is somewhat curved and is composed of an anterior (forward) and a posterior (rear) part: the anterior part is the forehead, which extends up and back from the bill to an imaginary line joining the anterior corners of the eyes; the remainder of the upper part of the head, the posterior part, is the crown. (Some authorities call the sloping posterior portion of the crown the occiput or hind-head.) Below the lateral boundary of the forehead and crown is the superciliary line. This is distinctively colored in some birds but not in the Common Pigeon or male English Sparrow.

The side of the head is rather flat and divided into the orbital and auricular regions.

The orbital region includes the eye, eyelids, and eye-ring. The eye as revealed through the circular eye-opening consists only of the dark pupil and pigmented iris. (The eyeball is actually of great size and can be felt under the skin.) Note that the pigeon's iris is bright orange or yellow. What is

the color of the sparrow's iris? \_\_\_\_\_ The eyelids, which are skin-folds, are two in number, one above the eye and one below. In the pigeon they are unfeathered and red. How do they differ in the

sparrow? \_\_\_\_\_ In all birds, as in mammals and in many reptiles and amphibians, the lids close the eye; only in birds, however, do the lids close the eye at death. Observe that at closure, in the pigeon and sparrow, the lower lid comes up more than the upper lid comes down. This is the rule among most diurnal birds; in most nocturnal species (e.g., owls and goatsuckers) and in a few others, the upper lid is the more mobile, as in mammals and alligators. The anterior corner of the eye (toward the nostril), where the eyelids come together, is called the nasal canthus; the posterior corner (near the temple in man) is called the temporal canthus. Find the nictitating membrane, sometimes spoken of

as the "third eyelid". It is a translucent, vertical fold under the lids on the side of the eye toward the bill. If the eye of a living bird is touched, the nictitating membrane--just before the lids close--slips obliquely across the exposed surface of the eye. Ordinarily, the membrane of both eyes, and the lids of both, act together (consensually) even when only one eye is touched. Birds, like mammals, blink periodically. The pigeon and a few other species blink with both the nictitating membrane and the lids, but most species, including the English Sparrow, blink with the nictitating membrane alone, the lids closing only in sleep or when the eye is menaced by foreign objects. In some birds (though not in the pigeon or sparrow), the feathers immediately around the eyelids are distinguished from the surrounding feathers by different color and are called collectively the eye-ring.

The auricular region is the area around the ear opening, which is concealed by a group of feathers called the auriculars. (The temporal region, between the auriculars and the orbital region, is small. Generally it is not used in describing birds but is considered part of the auricular region.) The area between the eyelid and the base of the upper part of the bill is the lore (between the eye-ring and the bill in those birds having an eye-ring).

The side of the head from the base of the lower part of the bill to the angle of the jaw (found by feeling for a bony prominence behind and below the ear) is called the malar region (cheek). It is bounded above by the lore, orbital region, and auricular region and below by the edge of the lower jaw.

The under (ventral) part of the head is flat and divisible into an anterior part, the chin, which is the feathered area in the fork of the lower part of the bill; and a posterior part, the gular region, which is a continuation of the chin to an imaginary line drawn between the angles of the jaw.

## THE NECK

The neck extends from the posterior margin of the crown to the trunk. It is divided into four regions: nape, jugulum, and sides. The upper, or dorsal, part is known as the nape. The lower, or ventral, part is called the jugulum. (The term "throat" is frequently used in descriptions of birds and includes the gular region of the head and the jugulum of the neck.) The side of the neck extends, between the nape and jugulum, from the posterior borders of the auricular and malar regions to the trunk.

## THE TRUNK

The trunk is divided into two surfaces: the upper parts, which include all the trunk above an imaginary line drawn from the shoulder-joint to the base of the outermost tail feathers; the under parts, which include all the trunk below this line. (Sometimes the terms "upper parts" and "under parts" are used to include the dorsal and ventral surfaces of the wing and tail, as well as those of the trunk.) The upper parts of the trunk are made up of the back and rump. The back is the anterior two-thirds of the area between the base of the neck and the base of the tail; the rump is the posterior one-third. The under parts are divided into breast, abdomen, sides, and flanks. The rounded portion of the under parts beginning at the lower border of the jugulum is called the breast; the flatter portion ending in an imaginary line drawn across the anus, or vent, is the abdomen. The breast and abdomen curve upward, forming the sides of the body. The parts that lie between the posterior half of the abdomen and the rump are frequently termed the flanks. Although technically the sides of the body belong to both the upper parts and the lower parts, the imaginary line separating the two surfaces is so high on the trunk that the sides of the body are generally considered regions of the under parts only.

Label on Plate I: Eyelids; iris; pupil; nasal canthus; temporal canthus; nictitating membrane (approximate position).

Label on Plate II, Figure 1: Head; neck; side of body; flanks; breast; abdomen.

Label on Plate II, Figure 2: Forehead; crown; occiput; superciliary line; auriculars; lore; malar region; chin; gular region; nape; jugulum; side of neck; back; rump; side of body; flanks; breast; abdomen.

### THE BILL

The bill consists of an upper and lower mandible, which lie, as their names indicate, above and below the mouth. Each mandible is a bony modification of the skull covered with a durable horny sheath. Thus the bill is a more or less rigid structure; along most of its length it is rather hard.

Notice that in the pigeon and the sparrow the lower mandible is a little shorter and narrower than the upper and much less deep. The bill is also customarily mapped out into a number of parts.

#### Upper Mandible

The ridge of the upper mandible -- the uppermost, central, longitudinal line -- is the culmen, extending from the tip of the mandible back to the bases of the feathers. It is formed by fusion of the two rounded sides of the upper mandible. Seen in profile, the culmen is somewhat convex, particularly toward the tip of the bill. The cutting edges of the upper mandible are the upper mandibular tomia (singular, tomium). Toward the base of each side of the mandible is a nostril. In the pigeon, over-arching the nostril posteriorly, is a soft, noticeably swollen structure. This is characteristic of pigeons and is called the operculum. The sparrow's nostril opens into a depression, the nasal fossa. This is common to the majority of small birds.

#### Lower Mandible

The cutting edges of the lower mandible are the lower mandibular tomia. They are overlapped slightly, when the bill is closed, by the upper mandibular tomia. Viewed from below the bill, there is a prong-like projection extending posteriorly on each side of the jaw. This is the mandibular ramus. The lowermost ridge of the lower mandible is the gonys and is formed by an anterior fusion of the rami. Like the culmen, it is somewhat convex when seen in profile. The sides of the lower mandible include not only the surfaces between the gonys and tomium but also the surfaces of the rami.

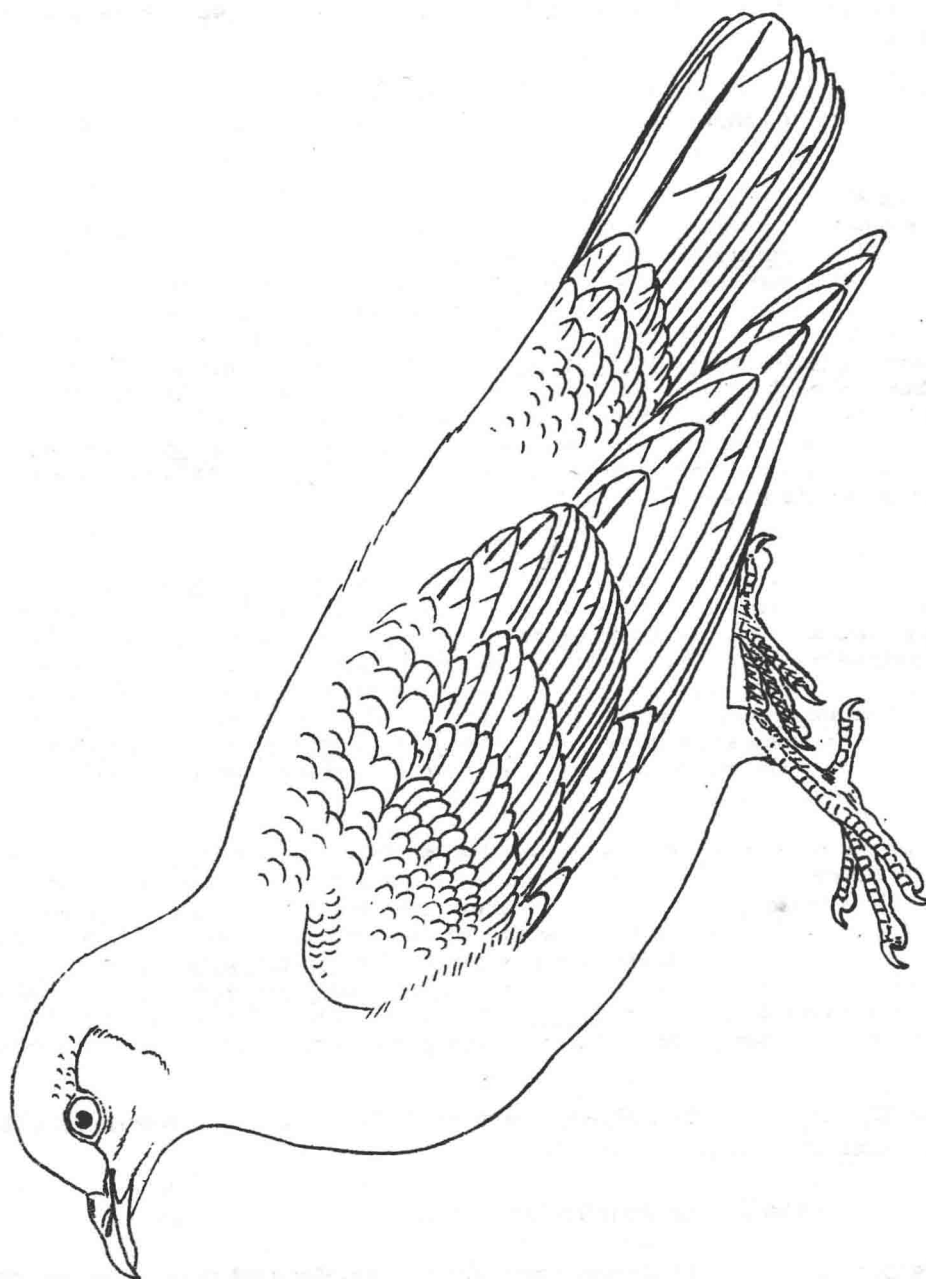
Several parts of the bill are evident when the two parts of the mandible are considered in relation to each other. The line along which the mandibles come together is the commissure or gape. (The term "commissure" is preferred to the term "gape", since the latter is often restricted to mean the space between the opened mandibles.) The point on each side where the mandibles meet posteriorly is called the commissural point (angle of the mouth). The tomium of each mandible has two parts: the tomium proper--the hard cutting edge of the mandible; and the rictus--the softer, more fleshy, part of the tomium near the commissural point. The rictus is more prominent in the English Sparrow than in the pigeon.

Label on Plate III, Figure 1: the culmen, upper mandibular tomium, lower mandibular tomium, rictus, tomium proper, nasal fossa.

Label on Plate III, Figure 2: the mandibular ramus.

Label on Plate III, Figure 3: the gonys, operculum, commissural point, nostril, commissure, mandibular ramus.

PLATE I



COMMON PIGEON



PLATE II

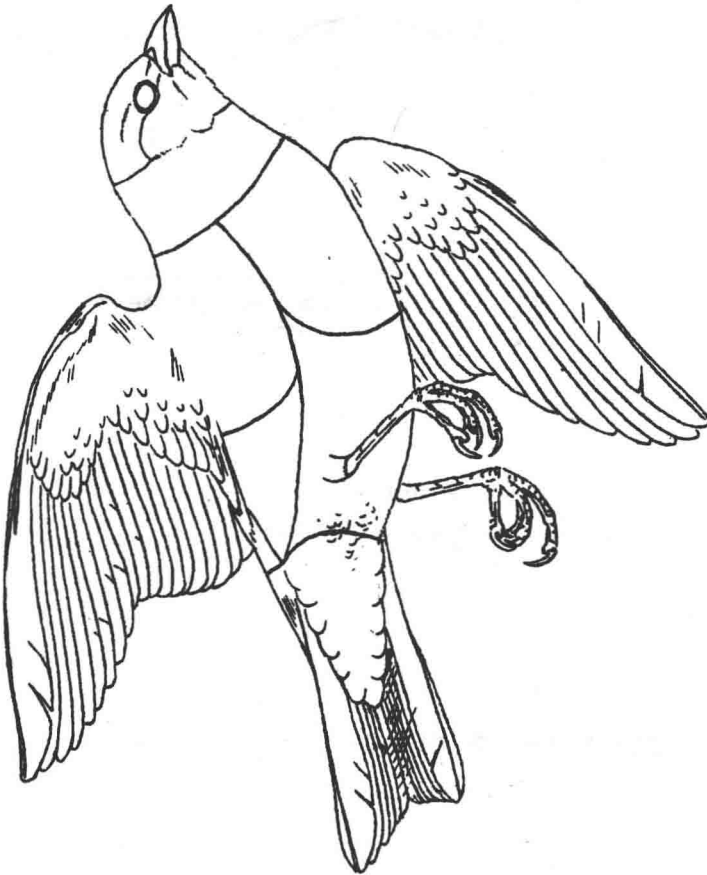


Figure 1



Figure 2

ENGLISH SPARROW