

A Catalog of an Exhibition of
Landmarks in the
Development of Ornithology

From the Ralph N. Ellis Collection of
Ornithology in the University of Kansas
Libraries

by
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University of Kansas Libraries
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Pellos & Herodios en Grec, Pella & Ardea en Latin, Heron en Francoys.



From Belon, *L'histoire de la Nature des Oyseaux.*

THE “. . . observation of Birds has been from a very remote period a favourite pursuit among nearly all nations, and this observation has by degrees led to a study more or less framed on methodical principles, finally reaching the dignity of a science, and a study that has its votaries in almost all classes of the population of every civilized country.” So at the end of the last century wrote Alfred Newton, among the most erudite of British ornithologists, in the historical introduction to his famed *Dictionary of Birds*. The statement is equally appropriate today, as is his definition: “Ornithology in its proper sense is the methodical study and consequent knowledge of Birds with all that relates to them; but the difficulty of assigning a limit to the commencement of such study and knowledge gives the word a very vague meaning, and practically procures its application to much that does not enter the domain of Science. This elastic application renders it impossible in any sketch of the history of Ornithology to draw a sharp distinction between works that are emphatically ornithological and those to which that title can only be attached by courtesy. . . .”

The present exhibit and catalog are designed to display and point out some of the most important landmarks—from the Renaissance forward—in the emergence of ornithology from an ill-assorted accumulation of fact, fancy, and folklore to accredited membership, and even, at times, leadership, in the family of natural sciences. Space has been available only for works, viewed with due respect to their times, which are “emphatically ornithological.” The exhibit was made possible by the fine Ralph Ellis library of ornithology which forms part of the Special Collections Department.

The Ellis Collection of literature pertaining to natural history consists of some 25,000 bound volumes, and includes as well a very large quantity of pamphlets, letters, original drawings, manuscripts, and other miscellany. Perhaps three quarters of the material, much of which is rare or in some way unique, is con-

cerned wholly or partly with ornithology. The library, of great value both for its cultural and esthetic content and for its utility in scientific research, was formed mainly in the years 1930-1945 by the late Ralph Nicholson Ellis, Jr. (1908-1945), through whose generosity it came ultimately to the University of Kansas. The present exhibit contains only scattered selections from the Ellis Collection, chosen for the importance of their content or for purposes of representation rather than for beauty, rarity, or monetary value. An extensive bibliographic catalog of the ornithology of the Ellis Collection is in preparation; publication plans will be announced soon.

RENAISSANCE ORNITHOLOGY: INVESTIGATION RENEWED

Most of the ornithological information and misinformation sketchily preserved through the first 12 centuries of Christianity descended from the classical era, and resulted from the labors of the brilliant investigator Aristotle (384-322 B.C.), and the diligent but uncritical encyclopedists Pliny (23-79 A.D.) and Aelian (*fl. ca.* 140 A.D.). Although some ornithological matter appeared in the learned codices of various religious orders, nothing of real note was produced until the 13th century. As the Renaissance in general was foreshadowed by the scholarly proceedings in the court of the emperor Frederick II of Hohenstaufen (1194-1250), so the first notable post-classical example of original ornithological observation was provided by the emperor himself, an ardent falconer, with his noted manuscript, *De Arte Venandi cum Avibus*, which is in fact a treatise upon ornithology as well as upon falcons, and contains much that is new. With the single exception of Albertus Magnus (1193-1280), who besides preparing several not very original works of his own edited Frederick's famous text, no one else seriously contributed to ornithological thought or observation between the time of Aristotle and the middle of the 16th century. Between 1544 and 1603, however, four notable works were published, marking the beginnings, however faint, of renewed attention to ornithological investigation.

WILLIAM TURNER (ca. 1500-1568)

William Turner, a prolific author (thirty-nine books) and a remarkable individual, has been called the father of British ornithology. Turner's rare little *Avium Præcipuarum*,* written at Cologne and there published in 1544, has the distinction, not only of being the first of countless books on birds written by Englishmen, but also of being the first serious criticism of classical writings on ornithology.

According to A. H. Evans (1903): "While attempting to determine the principal kinds of birds named by Aristotle and Pliny, [Turner] has added notes from his own experience on some species which had come under his observation, and in so doing he has produced the first book on Birds which treats them in anything like a modern scientific spirit. . . ."

Turner was frequently quoted by Gesner, next to be considered.

CONRAD GESNER (1516-1565)

One of the most learned men of the 16th century (Sir William Osler called him the "pattern man of letters" of his period) was Conrad Gesner, of Zurich. Among many other achievements he produced the first major bibliography (1545-1555) in the history of literature. Gesner's great *Historia Animalium* in four parts (1551-1558—a fifth part was published posthumously in 1587) has been called the starting point of modern zoology. Liber III of this work (1555), *Qui est de Avium Natura*,* deals in painstaking detail with 217 kinds of birds, real and imaginary (it is plain that the author discredited the latter), all illustrated by woodcuts. This work gave great impetus to the study of ornithology in subsequent generations.

Gesner's work on birds is remarkable for its scholarship. However, he contributed little to the subject of classification, employing for the most part the meaningless alphabetical arrangement general in the Middle Ages. In this matter, and in first-hand knowledge of birds, he was inferior to his less erudite

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contemporary, Pierre Belon, whose own great work on birds, published the same year as Gesner's, is next to be considered.

PIERRE BELON (1517-1564)

Pierre Belon, of Le Mans, is mainly known to ornithology through his remarkable work, *L'histoire de la Nature des Oyseaux*,* published at Paris in 1555. This book embodied a far greater amount of original observation than anything published up to the time, thereby remaining free from "most of the puerilities which disfigure other works of [its] own or of a preceding age" (Newton). The work included considerable information on the internal structure of birds and contained a classification which, though primitive and based partly upon Aristotle, was still an improvement on anything earlier attempted.

Belon will probably be longest remembered as one of the first, if not the first, to recognize the principle of homology (see his famous comparison of the skeletons of bird and man), and as such one of the founders of comparative anatomy. It is only fair to add in this connection, however, that among those who investigated bird anatomy he was soon surpassed by his contemporary, Volcher Coiter (1534-1576). Also contemporary with Gesner, Belon, and Coiter was Ulysses Aldrovandus, next to be considered, and the last of the notable Renaissance contributors to ornithology.

ULYSSES ALDROVANDUS (1522-1605)

In a long lifetime the Bolognese scholar and teacher Ulysses Aldrovandus, seemingly determined to eclipse his predecessors forever, assembled the materials for 14 bulky folio volumes on the three natural "kingdoms." The first 3 volumes (all but 4 were published posthumously) contained his *Ornithologiae** of 1599-1603. Unhappily the work is more conspicuous for size than for quality—in the words of Dr. Erwin Stresemann (1951:22): "*Aber nur der Fleiss Aldrovandis, nicht sein Geist konnte sich mit dem seines Vorbildes Gesner messen.*"

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Although considering himself vastly superior to Gesner, who honestly admitted the inferiority of the alphabetical arrangement of birds employed in his *Historia Animalium*, Aldrovandus employed the retrograde device of ranging his birds in what, essentially, is Aristotle's original classification.

Nevertheless, the work incorporated considerable new information on assorted matters, besides most of the contributions of Gesner, and added to a newly rising interest in ornithological matters. Like Belon's work, it is of interest in displaying some very early figures of American birds, among them the well-known Cardinal.

THE TURNING POINT: WILLUGHBY AND RAY ORNITHOLOGY BECOMES A SCIENCE

Although each in its own way contributed some new knowledge, all of the works so far mentioned were heavily burdened with unqueried legacies from the classical past. An ornithological labor incorporating a really improved classification, extensive first-hand observation of living birds, description and measurement of specimens, questioning the *reasons* for observed peculiarities of structure and behavior, and fixing a consistently critical scrutiny upon the foibles of earlier writers was not to appear until after the middle of the seventeenth century. It appeared at London in 1676 and 1678 (Latin and English editions respectively) in *The Ornithology of Francis Willughby** (1635-1672), edited, extensively enlarged, and issued posthumously by the latter's co-worker, John Ray (1628-1705).

It is difficult to speak too highly of this work. Stimulated by the rising spirit of inquiry of the times, to which Francis Bacon had materially contributed, Willughby and Ray travelled afield, studying and collecting together, in the effort to amass fresh information and to verify the statements of their predecessors, with whose works capable scholarship had thoroughly acquainted them beforehand. The work of these two men quite properly marks the emergence of ornithology as a science.

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THE GREAT PRE-LINNAEAN PERIOD OF ORNITHOLOGICAL DISCOVERY AND COMPILATION

Willughby and Ray gave impetus to the labors of many successors intent upon the accurate description and depiction of birds. So too the rising tide of exploration resulted in an ever-increasing flow of colorful and hitherto undreamed-of birds from foreign lands to European centers of learning. Travellers obscure and famous visited outlying parts of the world, sending back specimens and accounts which became grist for the mill of a rising school of ornithological compilers. Other ornithologists themselves went abroad in search of materials.

For a time, in the zeal for discovering the new and the novel, the classification of birds was largely forgotten, but a wealth of materials was assembled to await organization by later ornithologists, an organization much stimulated by the general adoption of Linnaean nomenclature (of which more later) in the late 1700's. Whether or not strictly pre-Linnaean, among the outstanding and typical figures of this period and its philosophy were George Edwards, John Latham, and Buffon, who stayed at home, and Mark Catesby, who went abroad.

MARK CATESBY (1679?-1749?)

Two periods of residence in the Carolinas and adjacent areas, 1710-1719 and 1722-1726, by the English gentleman-naturalist Mark Catesby resulted in the issue 1730-1748 of his monumental two-volume folio *The Natural History of Carolina, Florida and the Bahama Islands*.* This work is a first in several departments: the first great book entirely devoted to the American biota; the first respectable treatment of exclusively American birds (113 kinds are figured and described); and the first important example of the great showpiece type of folio natural history which, not altogether fortunately, became the vogue of the following century. Catesby has been called the founder of American natural history. His work provided the basis for approximately seventy Linnaean species of birds, and is still, as Dr. Elliott Coues put it

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(1878:584): “. . . classic, conspicuous in merit *inter congenerea sui temporis*, and indispensable for occasional consultation.”

GEORGE EDWARDS (1694-1773)

The beautiful work of Catesby was shortly followed by other handsome bird books describing new and interesting birds from various sources. The first of these, *A Natural History of Birds* (1731-1738) by Eleazar Albin, was of indifferent merit and almost immediately surpassed by the work of the distinguished naturalist George Edwards, the quality of whose ornithological illustrations surpassed all prepared earlier, including Catesby's. As originally issued, Edwards' work consisted of seven parts, the first four under title of *A Natural History of Uncommon Birds*,* the last three entitled *Gleanings of Natural History*, the whole published 1743-1764. There have been many subsequent editions, issues, and translations of Edwards' work. Among the many new species described by Edwards, not a few were from the New World and formed the basis of Linnaean names later applied.

GEORGE LOUIS LECLERC, COMTE DE BUFFON (1707-1788)

Buffon, who was without question one of the most prolific and literate natural scientists of all times, was as well a prominent and influential figure in the court and academy at Paris. Of his immense *Histoire Naturelle Générale et Particulière** as originally issued in 44 volumes quarto, 1749-1804, nine volumes devoted to birds were issued 1770-1783 under the subtitle *Histoire Naturelle des Oiseaux*.* Almost simultaneously the work was reissued with slight changes in 10 volumes folio, 1770-1786 (copy on display) as a deluxe edition of the birds designed to accompany Edme Louis Daubenton's (1732-1785) famed *Planches Enlumonnées*,* prepared at Buffon's instigation 1765-1780 and consisting of 1008 plates of which 973 are ornithological. The combined work is by far the most ambitious of the eighteenth century, perhaps of any century, and brought a new literary

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standard to natural history as well as introducing much new information and theory, and many new species. Although in fact post-Linnaean it is characterized in many ways by an eighteenth century spirit, being essentially a compilation, if a brilliant one, and pointedly ignoring the Linnaean nomenclature which had gained a strong foothold by the time of its inception. With other works of the period, Buffon's provided a rich field for the naming of species by others who are often erroneously taken to be the discoverers.

JOHN LATHAM (1740-1837)

Yet another industrious compiler who exerted a considerable effect on the course of ornithology was John Latham, whose three-volume *General Synopsis of Birds** (1781-1785; supplements 1787, 1802) contains the earliest descriptions of a very large number of species. In this, his major work, Latham did not employ Linnaean nomenclature, although he did achieve a classification not unsuccessful for its times. Too late to achieve formal credit for naming many of his own species (already endowed with binomials by Gmelin in 1788), Latham applied Linnaean nomenclature to the birds of the *Synopsis* in his *Index Ornithologicus* (1790).

THE BEGINNINGS OF MODERN CLASSIFICATION

Many steps were necessary to make possible the system in which animals are classified today, in a hierarchy of divisions designed to stand, however imperfectly, for the trunks, limbs, and twigs of a complex phylogenetic tree, the nature of which has yet been only partly ascertained by the persistent application of many lines of inquiry. Some of these lines are soon to be discussed. One of the most important basic steps, however, was that which provided a system for the orderly, uniform, simple, and permanent naming and characterization of animals and for a workable classification ultimately based upon the fundamental units, genus and species. For this gift, in 1758, biology is indebted

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to Carolus Linnaeus. It was not to be equalled in importance until the contribution of Charles Darwin exactly a century later.

CAROLUS LINNAEUS (KARL VON LINNÉ, 1707-1778)

For many years this gifted Swedish naturalist labored at Uppsala over his celebrated *Systema Naturae*,* intended to list and order all of the known kinds of plants and animals, and 12 editions authorized or supervised by the author appeared between 1735 and 1766. It was in the 10th edition (1758) that binomial, or as it is now often called, "Linnaean," nomenclature was first employed throughout, resulting in the ultimate selection of this edition as the starting point of modern zoological nomenclature. The outlines of modern classification are clearly visible in the *Systema*, where each form is identified as a species (represented by a single Latinized word and provided with a terse diagnosis) and placed, with or without others, in a genus (represented by another single word), the two together forming the Linnaean "binomial." The species, thus identified by binomial terms, form the building blocks of the plant and animal kingdoms, which are divided into larger (classes) and smaller (orders) units.

Linnaeus' main gift to ornithology, however, was limited to his system itself; his perception of natural affinities, highly developed in botany, was less evident in zoology and notably deficient in regard to birds. Here the Linnaean classification is little different from that of Ray and according to Newton, "where he departed from his model he seldom improved upon it." Some of Linnaeus' contemporaries were much better acquainted with birds and more adept at their classification.

MATHURIN JACQUES BRISSON (1723-1806)

Unlike many works published shortly after 1758, the great *Ornithologie** of Brisson (6 vols., quarto, Paris, 1760) is not an echo of the work of Linnaeus—a sudden capitalization upon the opportunity to apply Linnaean names to the species of earlier or

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unreformed authors. Rather it represents original thought and abundant personal observation of specimens (at Réaumur's Museum at Paris, where Brisson was curator) by a distinguished contemporary possessed of great ornithological knowledge.

Mainly written before the appearance of the 10th edition of the Linnaean *Systema*, the *Ornithologie* shows a clear comprehension of the nature of genera and species and of the utility of single-word designations at least for the former, while Brisson's actual perception of natural generic limits was superior by far not only to that of Linnaeus but of many later ornithologists. He seems to have been on the verge of drifting into strictly binomial nomenclature, but since he did not employ this consistently his specific names are untenable. His well-characterized genera, however, have been ruled valid and their names are in general use in ornithology wherever they enjoy priority.

Brisson's classification, the best of its times, was advanced in its recognition of the existence of many major groups. By an interesting coincidence, the number, 26, though of course not the content, of his orders of birds is nearly the same as that generally accepted today (Linnaeus had compressed all birds into 6 orders and 85 genera, the latter being somewhat more comprehensive than present-day families).

THE POST-LINNAEAN TREASURE-HUNT

With the acceptance of binomial nomenclature a tempting field was opened to those with the time and inclination to search the literature for species yet unnamed in the Linnaean style. Linné himself, of course, had based many of his own names on the descriptions of Aldrovandus, Belon, Gesner, Willughby, Edwards, Catesby, and others. So now his successors re-examined the ground. Among the more diligent were Pieter Boddaert (*fl.* 1784), who in 1783 published the very rare *Table des Planches Enluménées* naming the species figured by Daubenton, G. A. Scopoli (1723-1788), who named various species discovered on the voyages of Pierre Sonnerat (1749-1814) to New Guinea and elsewhere, and especially Johann Friedrich Gmelin (1748-1804), of the Academy at Saint Petersburg, whose ambitious,

so-called *13th edition** of the *Systema Naturae* culled many works, finding rich reward in the assiduous labors of John Latham. As a result of all this, diligent namers have sometimes been mistaken, to their undue credit, for brilliant discoverers.

Unoriginal as much of this effort was, some of it was conducted with great perseverance and respectable scholarship, and the practical if not the theoretical side of ornithology was materially benefited.

THE RADIATION OF ORNITHOLOGICAL STUDIES

Most important ornithological works produced prior to the year 1800 were general in nature, treating in greater or lesser detail all of the birds known to their authors (in which case some sort of classification was usually attempted), or some assemblage of birds united for no reason other than their novelty, the striking aspects of their plumage, or their accumulation upon a single voyage. With the increase of exploration and of scientific efforts, and after the adoption of the standard systematic nomenclature of Linnaeus had made possible the quick and orderly cataloguing of species, ornithological material began to accumulate at a staggering rate.

Specialization of approach to this growing mass of material became a necessity. Thus it is that it becomes increasingly difficult to give an orderly account of ornithological history, after approximately 1800, in straight chronological sequence. Rather it is necessary to examine independently the development of several approaches to the science, which may be arranged in the approximate order of their development, but each of which more or less overlaps the others. In the space available we may consider consecutively the study of faunas, of systematic groups, of avian morphology and classification, of infra-specific variation in birds, of natural history and behavior, and finally of the so-called "new systematics," a synthetic discipline applying the findings of these and many other fields to an effort to understand the interrelationships of animals. But it must be understood that even these are not all of the approaches to ornithological science.

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FAUNAL WORKS

Faunal works—publications devoted to all of the animals, or all of the animals of a particular group, in a given region—have carried a large share of the burden of assembling detailed information on the distribution and local habits of birds throughout the world. A vast variety of books and papers falls within the meaning of the term, from short contributions briefly describing the birds of a county to giant multi-volume, vastly expensive folios giving at least nominal attention to all the birds of a continent; from the most unscientific and unrevealing of commentaries to immensely detailed reviews of habits, distribution, environment, and geographic variation as encountered in a particular region. There has been a tendency in recent years for more ambitious faunal works to become increasingly limited in geographic scope; it is no longer possible to compress into convenient form the varied information expected of a conscientious faunist, for the birds of an area much larger than the average American state. Thus the functions of gathering data and drawing widely applicable generalizations have become increasingly separated.

A series of notable and representative faunal works of various types shown herewith represents only a minute fragment of the tremendous output of such works.

CASPAR SCHWENCKFELD (1563-1609)

The fourth book of Schwenckfeld's *Theriotropheum Silesiae*,* a medical text, lists and comments upon the birds of Silesia, under the subtitle of *Aviarium Silesiae*. Published at Liegnitz in 1603, the work, although little more than a curiosity today, is one of the earliest known examples of the faunal approach to ornithology.

CHRISTOPHER MERRETT (1614-1695)

The well-known *Pinax Rerum Naturalium Britannicarum** (London, 1666) contains the first printed list of British birds,

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naming approximately 170 species, and thus heads the longest list of faunal works devoted to the birds of a single island. The author was chiefly known as a botanist and physician.

WILLIAM BARTRAM (1739-1823)

Although a few predecessors resident in North America, for example John Lawson (d. 1712) in North Carolina, had produced trivial lists of American birds, the first really respectable treatment of a part of the United States avifauna by an American is found on pp. 284-302 of Bartram's famous *Travels Through North and South Carolina, Georgia, East and West Florida (etc.)*,* published at Philadelphia in 1791 and subsequently in many editions and translations across the world. The widely travelled and highly educated Bartram was a confidant and adviser of Alexander Wilson, the so-called "father of American ornithology," and has hence been styled by Dr. Coues its godfather.

LOUIS JEAN PIERRE VIEILLOT (1748-1831)

Until the time of Alexander Wilson, American birds were chiefly studied by non-resident ornithologists. We have noted the work of Catesby, the pioneer, followed by George Edwards and John Latham, discussed above, and by Johann Reinhold Forster (1729-1798) and Thomas Pennant (1726-1798). Prototypical among the works of Old-world ornithologists dealing extensively or exclusively with American birds, however, was Vieillot's *L'histoire Naturelle des Oiseaux de l'Amérique Septentrionale*,* issued at Paris in 1807. This work contained a great deal of new information on American birds, much of which received little notice until many years after its appearance.

ALEXANDER WILSON (1766-1813)

The first great resident naturalist to apply himself exclusively to American birds was the Scottish immigrant Alexander Wilson,

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who published his penetrating observations on some 280 species, nearly all figured by himself without great artistic skill but with faithful regard to detail, in the nine volumes of his immortal *American Ornithology*,* Philadelphia, 1808-1814. The last two volumes were completed by Wilson's friend, George Ord (1781-1866), and four "supplementary" volumes in the same style if not vigor were produced by Charles Lucien J. L. Bonaparte (1803-1857) in 1825-1833. Wilson's work marked the beginning of serious American ornithology.

JOHN JAMES AUDUBON (1770-1851)

The gap between the pioneer era of American ornithology, concluded with Wilson, and the modern era, begun by Baird, is bridged by a half-century dominated by Audubon and his works. Chief of these was the gigantic "elephant folio" *Birds of America* in 4 volumes, containing 435 superb aquatint engravings published 1827-1838. The letterpress was issued separately in modest format in 5 volumes (*Ornithological Biography*, Edinburgh, 1831-1839) containing much valuable information on American birds and written in a flamboyant style which nonetheless possesses literary merit and contains also interesting observations of early America. Both works were combined and issued 1840-1844 at Philadelphia as *The Birds of America** in 7 octavo volumes, with the plates much reduced in size and quality.

Audubon was a striking figure, both the man and his legend being always surrounded by commotion and controversy—his birth, his art, his ornithology, his meetings with Wilson and the eccentric C. S. Rafinesque (1783-1840), etc. Audubon and his works have a singular capacity to excite people, whether to hostility or admiration is immaterial. Thus two of the world's most gifted—and outspoken—commentators on ornithological history were able to speak, on the one hand, of "the magnificent folio plates" (Coues), and on the other, of the "egregious *Birds of America*" (Newton).

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JOHN GOULD (1804-1881)

In the upper-class world of mid-nineteenth century England perhaps no name was more identified in the public mind with ornithology than that of John Gould. What Thomas Bewick (1753-1828) had done for the general public with his *History of British Birds*, Gould did, on a much larger scale, for the gentry. A creditable ornithologist and a more than creditable businessman, Gould was responsible in his lifetime for the completion or inception of 12 distinct and major titles in folio (several produced in more than one edition) amounting in the aggregate to 47 volumes and approximately 3,100 lithographed and colored plates, an output doubtless unequalled by any other ornithological contributor. These huge works, about equally divided between monographs and faunas, dealt with the birds of many parts of the world, notably Australia, Asia, and New Guinea. Their ornithological value is not commensurate with their bulk and great expense but Gould, to his credit, usually published the more important of his findings separately in the periodical literature. Gould's major works are the prototypes of the deluxe folio type of ornithology produced in the nineteenth century for prestige possession.

BAIRD AND HIS CO-WORKERS

Spencer Fullerton Baird (1823-1887), from 1878-1887 Secretary of the Smithsonian Institution, not only contributed prominently himself to zoological science, but greatly stimulated and coordinated the work of his contemporaries, among them T. M. Brewer (1814-1880), John Cassin (1813-1869), and George N. Lawrence (1806-1895). Besides providing, by virtue of his position, much support to ornithological exploration of the American west, Baird also strongly influenced the thought and development of his brilliant successors Elliott Coues (1842-1899), J. A. Allen (1838-1921), and Robert Ridgway (1850-1929), who with others came to be known as "the American school" of ornithology. Baird's most important work, in its original form, was prepared (with limited assistance from Cassin

and Lawrence) as volume IX of the Reports of the U. S. Pacific Railroad Surveys (1858), and was subtitled simply *Birds*.* This work treated all of the birds then known from North America north of Mexico in a detailed and critical fashion and set the pattern for serious faunal works for many years afterward.

The most complete systematic work of its kind ever attempted, Ridgway's monumental *Birds of North and Middle America* (11 vols., 1901-), continued by Herbert Friedmann (1900-) and describing in minute detail all the known birds of this great area, is in a sense a continuation of the great work set in progress by Baird.

RECENT REGIONAL ORNITHOLOGY

Increasingly, detailed information on the local occurrence and natural history of birds has been incorporated into books and reports dealing with the birds of a single state or equivalent unit. These have ranged from quite luxurious semi-popular works with many illustrations to unassuming, paper-backed scientific reports. Some, such as *The Birds of Massachusetts* (3 vols., 1925-1929) by E. H. Forbush and *The Birds of Minnesota* (1932) by T. S. Roberts, have gone beyond their immediate purposes and served for years as general manuals useful over considerable areas. More recently, serious ornithologists have tended to separate the technical from the popular. Some admirable local works have been restricted to the presentation of detailed facts, variously, on the local distribution, ecology, systematics, and behavior of birds. *The Distribution of the Birds of California* (1944) by Joseph Grinnell and A. H. Miller and *Maine Birds* (1949) by Ralph S. Palmer are examples of such approaches to the subject. An excellent work intermediate between scientific and semi-popular extremes is *Florida Bird Life** by Arthur H. Howell, published in 1932.

MONOGRAPHS

Major works presenting all of the knowledge pertaining to given groups of animals are called monographs. Although com-

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mon in the ornithological literature, these are fewer than faunal works, since major groups of birds are less numerous than geographic areas. Some ornithological monographs have been confined to more or less detailed accounts of the appearance, range, habits, etc. of all birds admitted by the monographer to the group in question. Others have gone extensively into structural, behavioral, and other peculiarities of the groups concerned and attempted reorganizations (called revisions) of classification intended to display more accurately the internal relationships within the assemblages. Owing to advances in knowledge of relationships and consequent regroupings of animals, many earlier attempts have lost their "monographic" status and treat what must now be regarded as heterogeneous assemblages.

JEAN BAPTISTE AUDEBERT (1790-1800)
LOUIS JEAN PIERRE VIEILLOT (1748-1831)

These authors collaborated in producing one of the earliest ambitious monographs, *Oiseaux Dorés ou à Reflets Métalliques** (Paris, 1800-1802), treating a large assemblage of birds with little more in common, by present standards, than the possession of iridescent plumage. The work is no longer monographic except in regard to the hummingbirds and jacamars. It is noted for the metallic colors used on the plates in an effort to simulate natural brilliance.

RICHARD BOWDLER SHARPE (1847-1909)

A typical monograph of the middle and late nineteenth century is this well-known ornithologist's *A Monograph of the Alcedinidae: or, Family of Kingfishers** (London, 1868-1871).

JOHN CHARLES PHILLIPS (1876-1938)

*A Natural History of the Ducks** (4 vols. quarto, 1922-1926) by the versatile sportsman, naturalist, writer, and scientist stands as the last great illustrated monograph to appear, and in many ways is among the best, being rivalled in the present century

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only by the beautiful and valuable *Monograph of the Pheasants* (4 vols., 1918-1922) by C. William Beebe (1877-), of oceanographic fame.

MORPHOLOGY AND CLASSIFICATION

Early classifications of animals were, as Newton put it, "little more than the shuffling of cards, the ingenious arrangement of counters in a pretty pattern." Based at first upon the often superficial similarities of various creatures in diverse morphological, ecological, and physiological respects, these classifications created some weird alliances, as those of the whales and fishes and the birds and bats. The morphological characters of birds most popular for many years as bases for classification were the structure of the bill and feet, now known to be notoriously unreliable as indicators of deep relationship.

The utilization of more fundamental characters awaited the accumulation of a body of knowledge of the internal anatomy of animals. This was slow in accruing and did not begin to be really appreciable until the end of the 18th century. There is space here only to mention the primitive descriptive anatomy of such 17th century pioneers as Gerard Blasius (1623-1682), G. A. Borelli (1608-1679), and Claude Perrault (1613-1688), all of whom dissected some birds. Their discoveries had no immediate favorable effect upon avian classification, nor did even the much more advanced comparative anatomy of the great Baron Cuvier (1769-1832) a century later have much bearing strictly upon ornithology. It remained for the 19th century to produce a series of gifted anatomists who specialized upon birds and, with various success, applied their findings to the construction of more meaningful groupings.

CHRISTIAN LUDWIG NITZSCH (1782-1837) AND OTHERS

It has been almost traditional for avian anatomists to emphasize a single structure or system in their work and the classifications based thereupon, although many of them have modified their classifications according to the evidence of other structures and earlier works. (The modern synthesist attempts to take all

into account). So one of the earliest great morphologist-systematists of the 19th century, Blasius Merrem (1761-1824) emphasized the sternum, in 1812 separating birds into great ratite and carinate groups which still stand, and his successors Henri M. D. de Blainville (1777-1850) and Ferdinand J. l'Herminier also emphasized sternal characters. Nitzsch, likewise, while a well-rounded anatomist and an indefatigable worker from the early 1800's until his death (he contributed many pages of sound anatomical descriptions to J. F. Naumann's extensive *Naturgeschichte der Vögel Deutschlands*, 1820-1844), will always be remembered for his exhaustive and discerning studies of avian feather tracts, published posthumously in the *System der Pterylographie** (Halle, 1840), edited by Hermann Burmeister (1807-1892). This work stands as one of the great classics of avian anatomy.

WILLIAM MACGILLIVRAY (1796-1852)

While continental workers emphasized skeletal features and pterylography in their efforts to classify birds, MacGillivray, the most talented British ornithologist engaged in the same sort of work in the mid-nineteenth century, was pursuing investigations of the digestive tract. The first volume of his *History of British Birds** (1837-1852) contains a classification of birds founded on these investigations. MacGillivray is noted also for the anatomical descriptions which he prepared for the fourth and fifth volumes of Audubon's *Ornithological Biography*.

JOHANNES MÜLLER (1801-1858)

One of the greatest forward strides in advancing toward the present classification of birds, particularly in regard to the higher group known as passerines (song birds, etc.), resulted from the work of Müller, who in 1847 published his *Ueber die bisher unbekanntenen Typischen Verschiedenheiten der Stimmorgane der Passerinen* (*Abh. Preuss. Akad. Wiss.*, 1845 in part; reprint in full 1847; translation 1878 as *On Certain Variations in*

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the Vocal Organs of the Passeres That Have Hitherto Escaped Notice—* copy here shown). In this work for the first time the great systematic value of the syringeal muscles—those associated with the syrinx or voice-box—was first thoroughly appreciated and employed in classification.

DARWIN AND ORGANIC EVOLUTION

It is necessary to pause at this point to take note of a monumental event which occurred on July 1, 1858. On this day the celebrated views of evolution developed by Charles Darwin (1809-1882) were first made public, being published the following year as *On the Origin of Species by Means of Natural Selection*,* a work that revolutionized the scientific world. Darwin was by no means the first evolutionist, but he was the first to draw, however dimly, the outlines of a plausible mechanism of evolution. The effect upon ornithology, as upon other sciences, was rapid and profound. As Newton put it: "Until about this time systematists, almost without exception, may be said to have been wandering with no definite purpose. . . . Ornithologists now felt they had something before them that was really worth investigating. . . . Classification assumed a wholly different aspect. . . . Men began to figure to themselves the original type of some well-marked genus or Family of Birds."

Thus was born the concept of phylogeny in classification, which had great influence not only upon morphology, but upon avian paleontology and upon the study of species in the field (of which more below).

W. K. PARKER, AND OTHERS, IN LONDON

A paper by W. Kitchen Parker (1823-1890) entitled "On the Osteology of *Balæniceps rex*"* (*Trans. Zool. Soc. London*, 1860) was among the first of a long series of painstaking anatomical studies by this author which bear importantly upon problems of avian classification, and marks the beginning of a period of activity which was destined to flourish for several decades. Parker

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was soon joined by a number of highly capable workers in the field, several of them "Prosectors" of the Zoological Society. It would be impractical to list all the important contributors, but certainly to be mentioned are Alfred Henry Garrod (1846-1879), who stressed muscles of the thigh, William Alexander Forbes (1855-1883), who with Garrod emphasized muscles of the foot in classification of passerine birds, Frank Evers Beddard (1858-1925), author of the still very useful *Structure and Classification of Birds* (1898), and Peter Chalmers Mitchell (1864-1945).

THOMAS HUXLEY (1825-1895)

One of the great contributions to the classification of birds was made by Huxley, Darwin's friend and champion, with his researches on the osteology of the skull, especially the anterior palatal bones, and his consequent skillfully constructed arrangement of the class. The most important of several persuasive papers on this subject was entitled "On the Classification of Birds, and on the Taxonomic Value of the Modifications of Certain of the Cranial Bones Observable in the Class"* (*Proc. Zool. Soc.*, 1867:415-472). Previously, though with far less skill and effect, the importance of the avian palate had been urged by Joseph Emile Cornay (*cf. Revue Zoologique*, 1847:360-369).

OTHNIEL CHARLES MARSH (1831-1899)

The development of a body of information concerning avian paleontology was of great importance to the classification of Recent birds and the understanding of their evolution and anatomy. A pioneer work of high merit was Alphonse Milne-Edwards' *Oiseaux fossiles de la France* (1867-1871), and an American work of great interest was published by the veteran and prolific paleontologist Marsh, in 1880, as *Odontornithes. A Monograph of the Extinct Toothed Birds of North America*,* treating among others the great "loon-like" sea birds of the genus *Hesperornis* from the Niobrara Chalk of Kansas. Many works, large and small, have since appeared on fossil birds, a fine and fairly recent sum-

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marization of knowledge being found in the *Handbuch der Palaeornithologie* (1933) of Kalmán Lambrecht (1889-1936).

MAX FÜRBRINGER (1846-1920)

Among the most impressive single contributions is Max Fürbringer's monumental *Untersuchungen zur Morphologie und Systematik der Vögel** (1888), containing some 1,800 pages of minutely detailed and concisely summarized information, much of it new, as well as a classification of birds introducing important new ideas into systematic thought and largely revolutionizing avian classification. According to Beddard, after Fürbringer it was rarely necessary for an anatomist dealing with birds to refer to earlier work, so comprehensively was the subject reviewed. A disciple of the great Carl Gegenbaur (1826-1903), Fürbringer, following the pattern of his teacher, emphasized the shoulder girdle and forelimb in his work.

HANS GADOW (1855-1927)

Author of much of the ornithology (1869-1893) of Bronn's famous *Die Klassen und Ordnungen des Thier-Reichs*, this tireless ornithologist and anatomist skillfully constructed, on the basis of his own investigations and those of his predecessors, and somewhat on the lines established by his early co-worker Fürbringer, a classification of birds which in its broadest outlines clearly presages that in use today. Presented in great detail in the *Thier-Reich* in 1893, the classification may be seen in brief in the *Proc. Zool. Soc. London** for 1892 (pp. 229-256), here shown. The subsequent history of ornithological classification has been one of refinement, division of orders, moderate rearrangement of sequence, and increased attention to the interrelationships within orders and families. The broad outlines of classification of the class had been virtually established, whether or not correctly, by 1900.

STUDY OF THE SPECIES: MICROEVOLUTION

The early classifications of birds briefly reviewed above were constructed, mostly without conscious thought, upon the con-

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cepts of the enduring stability of nature and the immutability of the species, views held by nearly everyone up to the time of Linnaeus and indeed up to Darwin. In the very early 1800's a few workers began to name "varieties" within species, but these names were generally applied to the phases of polymorphic forms and had no geographic connotations. However, as early as 1840 in Europe and 1854 in North America, fixed local or geographic *variations* were noticed within species and recognized by name (a third name, or trinomial, being appended to the end of the Linnaean binomial).

From the time of Darwin on, great emphasis was attached to such studies, and it became apparent not only that species were variable, and divisible into "subspecies," but that the boundaries between species themselves were not always easy, or even possible, to determine. It soon became obvious to thinking workers that these variant local populations and "incipient species" might well be evolutionary units—that here was evolution in progress, at its lowest level, and indeed, though attempts have been made, no one has ever satisfactorily explained how evolution could proceed by any but minor steps. In time the disciplines of Mendelian genetics, and ultimately population genetics, did much to suggest, if not show, many of the mechanisms underlying the facts observable in nature.

HERMANN SCHLEGEL (1804-1884)

According to Stejneger (1885:70) the first use of trinomial nomenclature in the modern sense was made by the famous Swedish ornithologist Carl Sundevall (1801-1875), who applied subspecific names in recognition of variation within the species of several genera as early as 1840. Shortly afterwards, Schlegel employed the system of trinomials more extensively in his *Revue Critique des Oiseaux Europe** (1844), in which 27 subspecies were recognized, in addition to 489 species, and in which the law of priority was first recognized for trinomial names. Recognition of geographic "races" of birds and the application of trinomials was increasingly frequent on the continent of Europe from

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Schlegel's time on, although vigorously resisted (like most innovations) in England for at least four decades afterwards.

JOHN CASSIN (1813-1869)

The first use of trinomials for subspecies in America seems to have been their application in 1854 to geographic variants of the Great Horned Owl, in Cassin's *Illustrations of the Birds of California, Texas, Oregon, British, and Russian America** (1853-1856). In 1858 Baird employed trinomials in his *Catalogue of North American Birds* and some of his associates and successors soon became active in this department.

JOEL ASAPH ALLEN (1838-1921)

Although no trinomial names were employed in Allen's historic paper "On the Mammals and Winter Birds of East Florida"* (*Bull. Mus. Comp. Zoöl.*, 2:161-450, 1871), an important review of the geographic variation of North American birds was included therein. Although partly anticipated by Baird on some points and Ridgway on others, Allen here stated certain principles with unusual force and clarity, among them the idea of "the test of intergradation" for species, in effect that "subspecies of the same species intergrade with each other, species do not." This paper had an important influence on the future course of trinomialism in America and elsewhere, contributing as it did to understanding of the species.

REVISIONARY STUDIES OF GENERA AND SPECIES

As trinomial nomenclature and the concept of the subspecies were accepted, a vast new field was created for exploitation by taxonomists. By 1900 undescribed species were becoming very rare; besides providing new insight into the nature and variation of species, the "discovery" of the subspecies gave life to those whose chief goal was naming new kinds of animals. Unfortunately some of the devotees of this sport have lacked discrimination and conservatism and have not always been immune to the

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charge of undue haste. Whether or not done wisely, the naming of many subspecies (sometimes these were still described, hopefully, as "full" species) caused great proliferation of nomenclature and considerable confusion, and it became the task of "revisers" (who themselves frequently described still further forms) to make order of the chaos, examining large series of specimens, clarifying the facts of variation, and suppressing those names which proved to be synonyms. A large school of ornithologists devoted themselves to this activity, which in North America flourished especially from 1900 to about 1930. Among the most indefatigable of these was Harry Church Oberholser (1870-), whose *A Monograph of the Genus Chordeiles Swainson, Type of a New Family of Goatsuckers** (1914) is a typical revision of its period.

ALDEN HOLMES MILLER (1906-)

Much work devoted to geographic variation at the species and subspecies level up to approximately 1930 was purely descriptive and sometimes conducted by workers with poor biological backgrounds. Too often emphasis was placed on the naming of vaguely characterized "subspecies," sometimes from only one or two specimens, and too seldom was there careful description of populations and interpretation of the variation observed. No criteria for the degree of difference calling for recognition of subspecies were agreed upon, and rarely was the need for criteria discussed. Statistical methods suitable for biometric work, although available since the turn of the century, were employed rarely if at all by practicing taxonomists, at least in America, for several decades.

Among the first to apply thorough scrutiny and intensive statistical treatment to the populations of a single genus in North America was A. H. Miller with his "Systematic Revision and Natural History of the American Shrikes (*Lanius*)" (*Univ. California Publs. Zool.*, v. 38, 1931). Later appeared his exhaustive "Speciation in the Avian Genus *Junco*"* (*Ibid.*, v. 44, 1941), which may well be the most comprehensive consideration of the

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character and intergradation of populations within a single complex genus of animals. These works and others largely conducted or stimulated by a "California school" under Miller's influence, have introduced a new and fast-spreading approach to the study of the species and its subdivisions as evolutionary units.

THE STUDY OF AVIAN HABITS AND BEHAVIOR

The range of investigation embraced by this innocent heading is too broad for adequate treatment here. Several distinct but inter-related fields of endeavor are indicated: the general study of life-histories; the study of migration, movement, and orientation; the study of territorial and social relationships; and that observational-analytical approach to the whole range of avian activities which has come to be called the study of bird behavior, a close relative of psychology insofar as it attempts to clarify and interpret the reactions of birds to their environment in terms of their fundamental neuro-physiological organization. All, however, have one thing in common which distinguishes them from the disciplines already discussed; they depend extensively upon observation of the living bird. It will be possible only to mention isolated examples of different approaches to the bird as a living organism.

GILBERT WHITE (1720-1793)

Before any progress could be made in the study of the living bird in nature, it was necessary for emphasis upon outdoor observation to develop and a philosophy of reflection and inquiry to grow. Without doubt no individual contributed more to the earliest realization of these requirements than Gilbert White, the Vicar of Selbourne, whose *The Natural History of Selbourne** (1789), in the British County of Southampton, has undergone more editions than any other work on natural history in any language and which has converted dozens of later workers to the subject. Consisting mainly of letters to the author's friends Thomas Pennant and Daines Barrington (1727-1800), the work

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is largely devoted to birds, and its penetrating observations and queries concerning natural phenomena have seldom been surpassed either in literary style or simple accuracy. So the path was marked for a new and growing school of outdoor naturalists whose labors would ultimately supplement the findings of the museum worker and anatomist.

BENJAMIN SMITH BARTON (1766-1815)

In America observation of outdoor natural history rapidly found shrewd and sympathetic practitioners in the best tradition of Gilbert White. Among these, and already mentioned in a different context, was the highly literate William Bartram, with his classical *Travels* (1791). Notable in strict reference to ornithology, also, is Barton, whose rare *Fragments of the Natural History of Pennsylvania** (1799) is notable for being the first work by an American and devoted entirely to birds. It is, in addition, among the earliest careful comparisons of the relationship between bird migration and other phenological (seasonally-regulated) events. Of Barton the eloquent Coues wrote (1878:592), "The author had every qualification of a great naturalist except success, his actual achievements being far from commensurate with his eminent ability and erudition. . . . Had Barton reaped what he sowed, the fatherhood of American ornithology would be put back of Wilson."

ARTHUR CLEVELAND BENT (1866-1956)

Theoretical biology of any kind requires heavy underpinnings of factual knowledge. As Friedmann wrote (1933:101), "Generalized knowledge should always be the result and summation of particulate information." Thus great works compiling scattered information on the habits and life-histories of birds, while not themselves appreciably advancing knowledge, have contributed greatly to the general progress. Certainly the most ambitious ever brought (or now nearly brought) to conclusion is Bent's series (19 volumes published; 2 or 3 volumes in manuscript) on *The Life-histories of North American Birds** (1919-

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), in which are assembled huge stores of variously worthwhile information on the ecology, migration, nesting, food habits, and other behavior of all North American species. This work, to which most of the ornithologists of America have contributed at one time or another, is a standard starting point for investigations of many kinds. "Bent" brings to completion a project independently undertaken, under the same title, by Charles E. Bendire (1836-1897), only two volumes of which were published (1892-1895), and this work, in turn, supplemented T. M. Brewer's still earlier *North American Oölogy* (1857).

TERRITORIAL BEHAVIOR

Among the many particular aspects of bird behavior, territorialism, being those activities involved in the selection, advertisement, and utilization of defended and definitely bounded areas, or territories, by individual birds, has received a large share of attention. The results of study in the last few decades have modified or revolutionized concepts held at the turn of the century concerning, among other things, the significance of bird song, fighting between males, population structure, and the movements and family relationships of individual birds.

While most of the basic elements of the territorial concept were inherent in Bernard Altum's *Der Vogel und sein Leben* (1868), the theory was first clearly formulated as a result of work on the British warblers and other birds by Henry Eliot Howard (1873-), who summarized it in full in his *Territory in Bird Life** (1920). Subsequently much careful observation has been devoted to territorial behavior and related matters in individual species, among the most notable contributions to date being those of David Lack on the European robin (*Erithacus rubecula*) and Margaret Morse Nice (1883-) on the song sparrow (*Melospiza melodia*).

THE EXPERIMENTAL STUDY OF BEHAVIOR

The study of animal behavior has been conducted both by psychologists and zoologists, but the former have tended to con-

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centrate upon man. As an adjunct chiefly of zoology has fairly lately arisen the so-called "objective" study of animal behavior, or *animal ethology*, which has been broadly applied to lower animals, and which emphasizes study of the innate or instinctive actions of animals, their functions, causes, and evolution. An important school of animal behavior owes its origin chiefly to the brilliant Austrian Konrad Lorenz and has been further developed by the latter's capable student Nikolaas Tinbergen (1907-) and his own students and co-workers. Much work in animal ethology has been performed upon birds, some of it by ornithologists, and a broad descriptive basis for the interpretation of animal behavior is gradually being formed. A representative ornithological-behavioral study is Tinbergen's "Behaviour of the Snow Bunting in Spring" (*Trans. Linn. Soc. N.Y.*, 1939).

STUDIES OF BIRD MIGRATION

Through the ages no natural phenomenon has more appealed to the imagination of man, or posed greater mystery, than the rhythmic, seasonal comings and goings of birds. The predictable timing of these migrations, the great distances traversed in some instances, and the uncanny accuracy in navigation displayed even by young migrating birds, combine to add to the fascination of the subject. What factors initiate migration? How do birds find their way? Well into the present century the numerous works dealing with bird migration were restricted to varying combinations of observed fact and theory. Not until the 1920's was the experimental approach applied to the above problems and others bearing on migration. Very important among early experiments were those of William Rowan on the influence of day-length and gonadal condition upon the migratory behavior of juncos and crows. Rowan's work, originally reported from 1926 through 1932 in the *Proceedings of the Boston Society of Natural History* and of the *National Academy of Sciences*, rapidly caught the fancy of experimental scientists and led to an emphasis upon experimental method which has increased to the present day. Rowan's influential semi-popular book, *The Riddle of Migra-*

tion* (1931), briefly summarized his technical papers and clearly pointed out the importance of experiment.

STUDIES OF AVIAN PHYSIOLOGY

Again, a broad range of investigation is covered by the heading. Behavior, as Tinbergen has been at pains to emphasize (1951), is itself properly part of physiology. Physiology, again, has an important relationship to ecology, since the environmental relations of birds, and consequently their distributions, are governed in part by physiological tolerances. A representative specialized paper in bird physiology is S. Prentiss Baldwin and S. Charles Kendigh's detailed study of temperature and related conditions in the House Wren, rather ambitiously titled "Physiology of the Temperature of Birds" (*Sci. Publ. Cleveland Mus. Nat. Hist.*, 3, 1932).

THE NEW SYSTEMATICS

Systematics, or taxonomy, is the discipline of arranging animals in orderly and revealing systems. The term, "new systematics," is one which has been employed in the last few decades for a somewhat revised philosophical approach to the problems of systematics, an expanded and synthetic approach which attempts to take account of all available information from any branch of science in explaining the relationships of animals, and to bring uniformity to the procedures in widely varying branches of zoology and botany. Some wag has stated that the "new systematics" is neither new nor systematics; nonetheless, the trend so identified has been of great importance to zoology. Ornithology, being a well-developed branch of zoology, has contributed extensively to the subject, and ornithologists have been prominent in its development. Notable among the latter has been Ernst Mayr (1904-), whose pioneering work *Systematics and the Origin of Species** (Columbia Univ. Press, 1942), shown here, is closely identified with the early years of "the new systematics." A very similar work, interestingly, was independently prepared

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at almost the same time and quite by coincidence, by the German, Bernhard Rensch (1900-), under title of *Neuere Probleme der Abstammungslehre; die transspezifische Evolution* (Stuttgart, F. Enke, 1947). Literature of various types more or less identifiable with the new systematics has proliferated rapidly in the last few years.

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