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the Ecological Sciences series by F. N. Egerton*

A History of Ecological Sciences, Part 38A: Naturalists Explore North America, mid-1820s to about 1840

By the mid-1820s there were few American settlements beyond the Mississippi in the vast Louisiana Purchase. However, Americans began settling in Texas in the 1820s, and in 1836 Texans won a war of independence with Mexico; in 1845 Texas became a state. The vast Southwest belonged to Mexico until President James K. Polk provoked a war (1846–1848) and seized it, afterwards giving Mexico a U.S.-determined compensation. An imperialistic nation was eager to inventory its new real estate, and American naturalists were glad to oblige. Some naturalists continued private explorations, and the U.S. Government continued to sponsor expeditions, and on a larger scale than before.

This survey discusses (hopefully) the most important naturalists; for others, see book-length works. Many of the general and specific sources cited in Part 33 (Egerton 2009:434) are also helpful for this period. Additional sources include Robert Bruce, *The Launching of Modern American Science, 1846–1876* (1987), Margaret Welch, *The Book of Nature: Natural History in the United States, 1825–1875* (1998), Lester Stephens, *Science, Race, and Religion in the American South: John Bachman and the Charleston Circle of Naturalists, 1815–1895* (2000) and three histories of natural history studies in the Southwest: Samuel Geiser, *Naturalists of the Frontier* (1948), Edward Wallace, *The Great Reconnaissance: Soldiers, Artists and Scientists on the Frontier, 1848–1861* (1955), and Dan Fischer, *Early Southwest Ornithologists, 1528–1900* (2001).

Philadelphia Academy naturalists

Several naturalists who had explored before 1825 (Egerton 2009) continued doing so. Thomas Say (1787–1834), who had gone on expeditions in 1820 and 1823, joined Robert Owen’s utopian community, New Harmony, at the edge of civilization in southwest Indiana. He went there in January 1826 with his patron, William Maclure (1763–1840), a geologist (Warren 2009). They were accompanied by Charles-Alexandre Lesueur, whom we met in Part 35 (Egerton 2010:177) as an early student of plankton. He had come to America with Maclure in 1816 and had also been active in the Academy of Natural Sciences of Philadelphia (Schwarz 1997b, Stroud 1999b). Their departure was a blow to the Academy. These explorers underestimated the difficulties of involvement with the Academy from afar. However, they were in a good location to study a fauna little disturbed by Euro-Americans.

In America, Lesueur aspired to write a natural history of American fishes. He was a talented artist, and like many other artist–naturalists since the time of Leonardo da Vinci, he was more persistent at drawing than at writing, and his work remained unfinished. However, he published a number of articles describing unknown species (Ord 1849:215–216). One example is Lesueur’s “Descriptions of the five new species of the genus *Cichla* of Cuvier” (1822). He explored from Philadelphia, and later from New Harmony, with trips along the Ohio and Mississippi rivers, and he frequented fish markets, but also

caught his own fish. He was the first naturalist to study Great Lakes fishes. He named five genera, three of which are considered valid (Jackson and Kimler 1999:529). Besides illustrating his own studies, he illustrated natural histories of others.

He also drew over 1200 sketches of the American frontier, the earliest such illustrations for places he visited; many of them are now published (Jordan 1933, Vail 1938, Hamy 1968, Stroud 1992:162, 176–181, 227).

Thomas Say had begun publishing articles on both insects and bivalves in Philadelphia, and since he also began publishing *American Entomology* (1824–1828) before leaving there, those three volumes were discussed in Part 33 (Egerton 2009:468–470). However, since he only began publishing his seven-part *American Conchology* (1830–1836) after moving to New Harmony, it is discussed here. The boat, *Philanthropist* (later dubbed the “Boatload of Knowledge,” illustrated by Lesueur in Stroud [1992:180–181]), that carried the naturalists from Pittsburgh on 8 December 1825 down the Ohio and Mississippi rivers and up the Wabash to New Harmony, also carried several women from New York City, including Lucy Way Sistare (c.1800–1886; portraits in Weiss and Ziegler [1931: facing 214], and Stroud [1992:270]), whom Say later married.

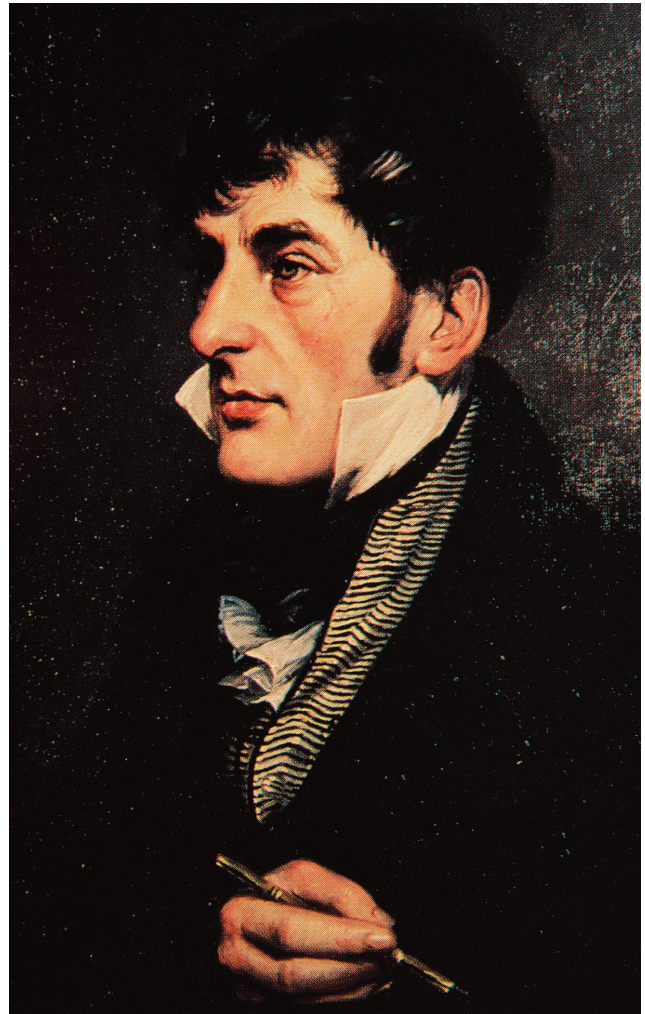


Fig. 1. Charles-Alexandre Lesueur, by Charles Willson Peale, 1818. Academy of Natural Sciences of Philadelphia.

She drew 66 plates for *American Conchology*, the remaining two being by Lesueur, Lucy’s art teacher (Stroud 1992:243–244). She also supervised the hand coloring of the prints and did much of the coloring herself. Because of the difficulty of publishing books in Philadelphia with authors in New Harmony, Maclure bought a printing press, which published *American Conchology* (Banta 1938, MacPhail 1983a). Both this work and Say’s earlier articles on bivalves were reprinted posthumously (Say 1858).

Although many explorers returned to civilization and published their own discoveries, other naturalists did little or no exploring but served the cause of exploration by publishing the discoveries of others. We met George Ord (1781–1866) in Part 33 (Egerton 2009:458–459) as a member of the Academy of Natural Sciences of Philadelphia and as Alexander Wilson’s colleague, who finished the *American Ornithology* after Wilson died. Ord went on one expedition to Florida and on shorter trips around Philadelphia with Wilson, but primarily published the discoveries of others. So did two other members of the Academy, physicians John Davidson Godman (1794–1830) and Richard Harlan (1796–1843). Both taught medical

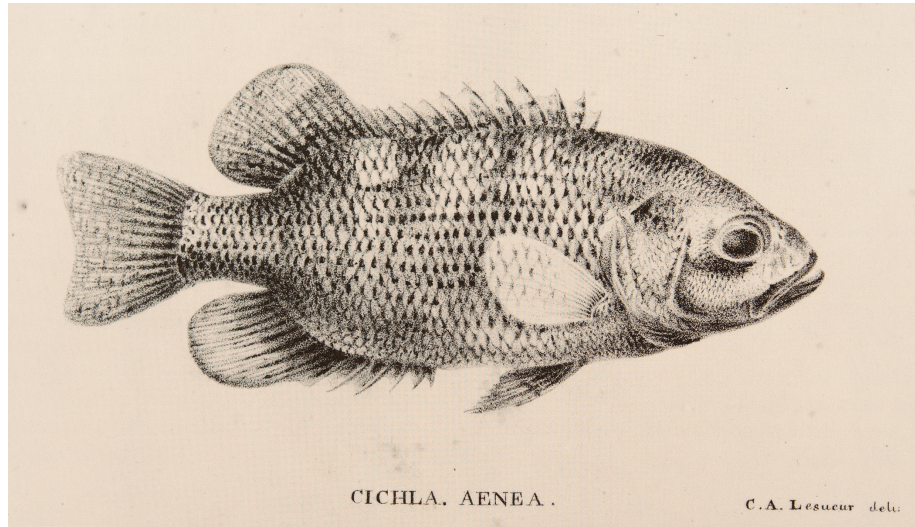


Fig. 2. *Cichla aenea*. Lesueur 1822: facing 214.



Fig. 3. *Unio ventricosus*. Say 1830–1836.

students. Harlan was interested in paleontology and studied western mammals brought back East by Nuttall, Titian Peale, and Audubon (Bell 1972, Faul 1997b, Gerstner 1999). He included both living and fossil mammals in his *Fauna Americana* (1825), which emphasized anatomy and classification. Godman was busy writing his own survey of mammals entitled *American Natural History* (three volumes, 1826–1828), which included uncolored plates of mammals drawn by Lesueur (Fig. 4).

Harlan and Godman's works were more complementary than overlapping, but Godman sought to protect the market for his own pending work by publishing a harsh review of Harlan's (Stroud 1992:206–207, Welch 1998:54–55). Harlan could give as good as he got, and published an attack on an anatomy text that Godman had published in 1824. Harlan also published four articles on American herpetology (1825–1835) which Adler reprints (Adler 1978a). Godman had to give up teaching because he was dying of tuberculosis (Morris 1974, Porter 1983:75–76, Faul 1997a, Carey 1999). In his last year of life he wrote a dozen nature essays for a Philadelphia weekly, *Friend*, and he may have been first to



Fig. 4. Wolves, drawn by C. A. Lesueur, engraved by F. Kearny. Godman 1826–1828.

publish a regular series of nature essays. They were collected into a small posthumous book, *Rambles of a naturalist* (1833), that has been compared to Gilbert White's *Natural History of Selborne* (1789). However, White wrote in detail for other naturalists about new discoveries (Egerton 2007), while Godman wrote briefer popular essays.

Another naturalist who never went far beyond the Atlantic coast was Charles- Lucien Jules Laurent Bonaparte (1803–1857), Napoleon's nephew, who was born and died in Paris, but grew up in Italy and England (Petit 1970, Stresemann 1975:153–169, Brodhead 1978, 1997, Farber 1982:116–119, 121–122, Mearns and Mearns 1988:75–82, Stroud 1999a, Walters 2003:102–103). His political sympathies were democratic, though he was more interested in natural history than politics. He sailed to New York in August 1823 and arrived on 8 September. During the voyage he caught fish, turtles, and birds, including petrels (Stroud 2000:34). He and his wife moved to Philadelphia in early January 1824, and on the 13th Bonaparte attended a meeting of the Academy of Natural Sciences of Philadelphia at which Say read Bonaparte's paper on stormy petrels, which later appeared in the Academy's *Journal* (Bonaparte 1824). On 24 February he was elected a member.

The Academy's collections included undescribed birds that Titian Peale and Say had collected on the Long Expedition, 1819–1820 (Egerton 2009:462–468). Bonaparte was interested in determining which American bird species were the same as in Europe, and he found some species where Wilson had thought that the males and females were of different species. Bonaparte thought that Wilson had



Fig. 5. Charles-Lucien J. L. Bonaparte, by Charles de Châtillon, before he went to America. Museo Napoleonico, Rome.

named some species already named by Europeans, especially Vieillot (Egerton 2009:459). Bonaparte decided, therefore, to write a continuation of Wilson's volumes (Bonaparte 1825–1833). However, Bonaparte was a systematist, not a natural historian, and for his information on natural history he drew upon the observations of others. In April 1824 a mutual friend introduced him to Audubon, and their relationship proved mutually beneficial, despite occasional friction. Bonaparte introduced Audubon to the naturalists at the Academy, where Audubon had a mixed reception—welcomed by some, but not by Wilson loyalists (Stroud 2000:55–57, Rhodes 2004:220–223). In October, Bonaparte hired Peale to

collect birds for him in Florida, 24 October 1824–25 April 1825 (Poesch 1961:49, Stroud 2000:53–54). Peale had become head of his deceased father’s museum, and specimens he painted and Bonaparte described were deposited there.

Peale’s illustration for Bonaparte of the Burrowing Owl and the Cliff Swallow is reproduced in Part 33 (Egerton 2009:Fig. 24). The introductory paragraph to Bonaparte’s account of this swallow’s natural history indicates how he proceeded (Wilson and Bonaparte 1832, III:216)

With the exception of a very imperfect description, little was known relative to this interesting bird anterior to Long’s expedition to the Rocky Mountains. One of his notes annexed to the account of that journey contains an excellent description of this swallow, with a notice of its habits, and remarkable manner of building. Mr De Witt Clinton has recently published a paper on the same subject, accompanied by some observations from Mr Audubon. Combining what these gentlemen have made known with the information previously given by Vieillot and Say, we can present a tolerably complete history of the cliff swallow.

Bonaparte did not get along well with Ord, and both were disappointed when Say, Lesueur, and Maclure left Philadelphia for New Harmony. Since Bonaparte’s ties to Philadelphia were weakened, he traveled to New York, London, and Brussels and back again before leaving America permanently on 5 January 1829. In *A Geographical and Comparative List of the Birds of Europe and North America* (1838), Bonaparte separated out a new genus of doves from the overly-broad *Columba* and named it *Zenaida*, after his wife (Mearns and Mearns 1992:101–104). A gull that Ord named *Larus philadelphia* received its common name, Bonaparte’s Gull in 1931 (Mearns and Mearns 1992:94–100).

Frontier naturalists

Constantine Rafinesque (1783–1840), whom we also met in Part 33 (Egerton 2009:470–472), also published articles on American bivalves, 1818–1832, which were collected posthumously (Rafinesque 1864, 1984, Bogan 1988). In “Continuation of a monograph of the Bivalve Shells of the River Ohio, and other rivers of the Western States”(1831), he complained about the mistakes of four American conchologists (quoted from Rafinesque 1864:71)

...they have neglected to verify, or properly notice my previous labors, although they were known to them. Mr. Say is, above all, inexcusable. I had respectfully noticed, in 1820, his previous labors; but he has never mentioned mine, and knows so little of the animals of these shells, as to have mistaken their mouth for their tail, and their anterior for the posterior part of the shells!

If he had seen these animals alive, feeding, moving, and watched their habits as I have done repeatedly, he would not have fallen into such a blunder.

Since Say had lost interest in Rafinesque’s work, he may not have read this rebuke. In 1833, Rafinesque, in *Herbarium Rafinesquianum*, announced “the great universal law of PERPETUAL MUTABILITY in every thing” (quoted in Hanley 1977:141). In Part 33 (Egerton 2009:472) we saw that Rafinesque, in *Botany of Kentucky* (1819), divided that state’s vegetation into four, or possibly five, floristic regions. In his *New Flora of North America* (1836), he divided North America’s vegetation into seven floristic

regions (Ewan 1969:116). He wrote 9 botanical letters to Augustin-Pyramus de Candolle, 1817–1821, and 13 more, 1830–1839 (Baehni 1957).

John James Audubon (1785–1851) is the most famous American naturalist (Peattie 1936:240–243, Welker 1955:71–90, Adams 1969:182–197, Stresemann 1975:312–314, Elman 1977:80–123, Kastner 1977:207–239, Farber 1982:105–106, Gibbon and Strom 1988:58–75, Mearns and Mearns 1992:22–27, Blum 1993:88–118, Cooper 1997, Sterling 1999a, Fishman 2000:136–156, Moring 2002:124–135, Walters 2003:100–101). Henry David Thoreau is also popular, but Audubon has an edge, because his bird illustrations can be immediately appreciated upon seeing them, whereas one must take the time to read Thoreau's writings to appreciate him. There are more biographies of Audubon than of any other American naturalist—far more than are listed here (Herrick 1917, Ford 1964, Adams 1966, Streshinsky 1993, Rhodes 2004). He also left substantial autobiographical writings (Audubon 1897, 1965, 1969, 1999). He is an interesting challenge for a biographer, but a difficult challenge for a historian. He had artistic talent and spent much time observing and collecting birds and mammals, and he was an energetic and persistent artist and author. However, his education was limited, and his veracity fluctuated (Herrick 1917, Stroud 2000:56). His invention of 11 species of fish which he foisted off on Rafinesque was discussed in Part 33 (Egerton 2009:470–472). The challenge is to appreciate both his achievements and failings. His father was a French sea captain, and the son was more interested in drawing than in a naval education. To evade Napoleon's military conscription, the father sent him in 1803 to Pennsylvania to help manage a farm. He failed at that, but later he wrote that he had developed there, in 1805, a method of drawing birds by using wires to mark off a grid on a board to which he pinned his specimen, and he duplicated the grid on the paper on which he drew it (Audubon 1999:754–761). There he was fortunate to find a loyal wife, Lucy Bakewell (1787–1882), for they had many years of struggle before he achieved fame as an artist–author (DeLatte 1982). In 1807 they traveled to Louisville, Kentucky, where he became a partner in running a store. They had two sons there, who grew up to become his valuable assistants: Victor Gifford Audubon (1809–1860) and John Woodhouse Audubon (1812–1862).

On March 19, 1810, Alexander Wilson entered the store, having been told about Audubon's interest in birds by Lucy's uncle, Benjamin Bakewell, when Wilson was in Pittsburgh (Rhodes 2004:63, 66). This was a very consequential meeting for Audubon, but not for Wilson (Welker 1955:48–58), who hoped to sell a subscription to his *American Ornithology*. Audubon was tempted, but the store was not prosperous and his partner persuaded him not to. Wilson's journal account of meeting Audubon and going on an excursion with him only appeared posthumously in Ord's biography (Ord 1828:clxvi). When Audubon read it, he felt slighted, and some Audubon biographers have suspected Ord altered it, since Ord was hostile to Audubon, and Wilson's manuscript has disappeared (Herrick 1917, I:223–224). Audubon later published his version of their interactions (1831–1839, I:437; reprinted in Herrick 1917, I:220–221), which must be read with caution. That was not the end of the matter; Audubon later accused Wilson of both plagiarism and failing to acknowledge Audubon's information in his account of the whooping crane. Neither accusation has withstood scrutiny (Burns 1908a, b). On the other hand, Audubon's unacknowledged copy of several Wilson illustrations in *Birds of America* (four volumes, 1826–1838) are obvious (Welker 1955:Figs. 7–12, Cantwell 1961:250–251, Hunter 1983:92–97 + Figs. 15A–17B). For example, Wilson's right-facing male Mississippi Kite (Egerton 2009:fig. 18) became a left-facing female in Audubon's Plate 117 (1831). Audubon defenders have suggested that Audubon's publisher and engraver Robert Havell, Jr., might have added Wilson's figure to the plate without Audubon's knowledge, but if so, Audubon neither acknowledged this in later editions of *Birds of America* nor removed it from



Fig. 6. John James Audubon, by Victor Gifford Audubon and John Woodhouse Audubon, about 1841. The American Museum of Natural History, New York.

his plate. Some Audubon illustrations are very similar, though not identical, to Wilson illustrations, including the Bald Eagle (Wilson's No. 36, Audubon's No. 14). Audubon wrote that he had visited Wilson in Philadelphia in December 1811 while Wilson was working on that illustration (Wilson 1808–1814, IV: Plate 36). It is difficult to blame Havell for Audubon's illustrations very similar to Wilson's!

In the recession of 1819, Audubon went out of business, which freed him to pursue his ornithological ambitions. In his essay on Wilson, Audubon (Audubon 1999:535) pretended he had not thought of publishing his drawings until after he had met Bonaparte in 1824, but when he and his assistant, Joseph Mason, left for Louisiana on 12 October 1820, he had letters of introduction from Henry Clay and others stating his goal of publication (Herrick 1917, I:307). Audubon and Mason had a memorable stay, 18 June to 20 October 1821, at Oakley Plantation, near St. Francisville, Louisiana, where Audubon served as a tutor. He painted there about a quarter of the illustrations for his *Birds of America*, including mocking birds and a rattlesnake, and Mason painted in the background plants. Oakley House and a few acres are now preserved as Audubon State Historic Site (Durant and Harwood 1980:220–230, Rhodes 2004:195–204, Heitman 2008). As Audubon collected and painted, he consulted Wilson's *American Ornithology*: “We purchased this Morning in Market a Beautiful *Blue Crane Ardea Cerulea*....I Drew it, and its

Cor[r]esponding so well with A. Willson Description Stop^d Me from writing it Myself” (1999:89).

Audubon aspired to outdo Wilson not only in observations and illustrations, but also in publications. Since Ord and Lawson were hostile to his efforts in Philadelphia in 1824, he sailed on 17 May 1826 to Liverpool, and eventually he found the engraver–publisher of his illustrations in Robert Havell, Jr., in London (Audubon 1897, I:79–342). The life-size plates were so large they were called “double elephant folio.” Publication of four huge volumes (1827–1838) was quite a feat, requiring Audubon to peddle his wares the way Wilson had his (Hart–Davis 2003, Souder 2004, Vedder 2006). To write his text, Audubon needed expert editorial help, and since he wanted to write it in Britain, he recruited Edinburgh naturalist William MacGillivray (1796–1852), who lacked knowledge of American birds (Mearns and Mearns 1992:309–314, Ralph 1993, Hart-Davis 2003:177–180, Bircham 2007:146–153). (MacGillivray later wrote *A History of British Birds*, five volumes, 1839–1843.) Audubon’s *Ornithological Biography* (five volumes, 1831–1839) included not only his accounts of bird natural histories, but also “Episodes” on his experiences in America, intended as human-interest diversions. The episodes discussed Alexander Wilson (“Louisville in Kentucky”) and Constantine Rafinesque (“The Eccentric Naturalist”) (Audubon 1897, II:199–203, 473–480). He published an octavo edition of both illustrations (500 plates) and text, minus the episodes (seven volumes, 1840–1844). This also was a large undertaking (Tyler 1993). The episodes were republished in *Audubon and His Journals* (1897, II:199–527).

After returning to America on 1 May 1829, Audubon traveled extensively (Durant and Harwood 1980), north to Labrador (Audubon 1897, I:343–445), south to Florida (Fishman 2000:136–156), and west to Texas (Geiser 1948:79–94) collecting birds and information. Audubon’s last expedition up the Missouri River in 1843, in quest of mammals (see below), yielded a new bird species, Western Meadowlark, at Fort Union, North Dakota (Boehme 2000:120). He also named the Harris’ Sparrow for friend Edward Harris, who accompanied him on the expedition; Townsend (see below) had prior claim for the scientific name, but Audubon’s commemoration remains in the common name (Harris 1951: facing 48).

One of Wilson’s biographers decided to conclude on a gracious note an article defending Wilson from Audubon’s slanders: “As to the two men’s respective achievements, each was a citizen of the highest worth, the one as scientist, the other as artist” (Stringham 1953:52). That Audubon was an artist, but not a naturalist, had been previously stated in 1833 by Frédéric Cuvier (Farber 1982:106) and in 1845 by John Cassin (Peck 1991, I:3). However, it is inaccurate to dismiss Audubon as only an artist. Despite the fact that some of his claims can be shown to be deliberate fabrications, he went to considerable lengths to make detailed observations on wild birds, and even experimented to see if vultures could smell carrion—he found they could not (Audubon 1826). It is unlikely that he knew of Frederick II’s comparable experiments during the 1200s (Egerton 2003:42). All scientists are prone to make “honest” mistakes; in Audubon’s case, some of his mistakes were honest, but others were dishonest. A famous example in which Audubon’s accuracy was challenged was his very dramatic illustration of mockingbirds, in which a rattlesnake seeks eggs in a nest.

Skeptics doubted that rattlesnakes climbed trees and even questioned the re-curved shape of its fangs (Ford 1964:220). Audubon’s article on the rattlesnake (1827) was also met with skepticism (Herrick 1917, II:71–77). One of Audubon’s defenders dismissed both Audubon’s illustration and his verbal



Fig. 7. Four mockingbirds defending a nest against a rattlesnake. The jasmine tree was drawn by an assistant, Joseph Mason, unacknowledged by Audubon. Audubon 1827–1838, I: Plate 21.



Fig. 8. Florida rat (*Neotoma floridiana* Say and Ord), male, female and young, by J. J. Audubon. Audubon and Bachman 1846–1854, I: Plate 4, Audubon and Bachman 1989: Plate 4.

account (1831–1838, I:108–114), allegedly witnessed in 1821, as “sheer nonsense” (Murphy 1956:335). Today, one might question the likelihood of four adult mockingbirds defending one nest, since this species is territorial. Crows gather to mob an enemy, but do mockingbirds? Audubon claimed they do in the revised version of *Birds of America* (1840–1844, II:190, 1967)

Different species of snakes ascend to their nests, and generally suck the eggs or swallow the young; but on all such occasions, not only the pair to which the nest belongs, but many other Mocking-birds from the vicinity, fly to the spot, attack the reptiles, and, in some cases, are so fortunate as either to force them to retreat, or deprive them of life.

We can question Audubon's claims of snakes sucking rather than swallowing eggs, and his snake's eyes incorrectly have round pupils. Wallace Craig (1911:423–425), who studied captive Passenger Pigeons before they became extinct, criticized both Audubon's account and illustration. Five of Audubon's drawings cannot be identified to species; some may represent hybrid individuals (Parkes 1985). Susanne Low (2002) has facilitated research on Audubon's ornithology with a concordance of his bird names and those currently used. Audubon drew many insects and some lizards, some of which he copied onto his bird portraits (Ford 1952).

On 17 October 1831, Audubon arrived in Charleston, South Carolina, in quest of subscribers for *Birds of America* and new birds to illustrate. There, he met John Bachman (1790–1874), a naturalist and Lutheran minister who had known Alexander Wilson while living in Philadelphia (Mearns and Mearns 1992:28–38, Shuler 1995, Sterling 1997a, Stephens 1999). Bachman already admired Audubon's work and invited him and his two assistants to stay at his house. They did, for a month. Audubon and Bachman became close friends, and later Audubon's sons married Bachman's two oldest daughters. In 1839 Audubon finished his *Ornithological Biography*, and he and Bachman agreed to produce a treatise on America's mammals. Audubon accepted Bachman's requirement: "the Book must be original & credible—no compilation & no humbug" (Shuler 1995:169). Audubon provided illustrations and Bachman the text (Welch 1998:56–58). Of course, such a work was a compilation, of their observations plus cited information from other authors. Audubon's last expedition was up the Missouri River in quest of mammals (Audubon 1897, I:447–532, II:1–195, Harris 1951, McDermott 1965, Durant and Harwood 1980:538–598, Boehme 2000). His and Bachman's *Viviparous Quadrupeds of North America* (1846–1854) exceeded Godman's *American Natural History* (1826–1828) in having colored plates, encompassing more species, and having more first-hand observations.

In 1846 Audubon's eyesight failed, and he became senile in 1847. John Woodhouse Audubon provided 73 plates, to his father's 77 (5 plates lack artist identification). Being unaware of Pacific sea otters' invertebrate diet, eaten at sea, John drew one on land, holding a fish like a river otter (Plate 137). Some species were described without illustration. Bachman was the taskmaster who kept the project moving forward (Peck 2000:107). Victor Gifford Audubon handled the business of publishing. Here is part of the account of the Florida rat (Audubon [and Bachman] 1989:25)

There are considerable differences in the habits of this species in various parts of the United States, and we hope the study of these peculiarities may interest our readers. In Florida, they burrow under stones and the ruins of dilapidated buildings. In Georgia and South Carolina they prefer remaining in the woods. In some swampy situation, in the vicinity of sluggish streams, amid tangled vines interspersed with leaves and long moss, they gather a heap of dry sticks, which they pile up into a conical shape, and which with grasses, mud, and dead leaves, mixed in by the wind and rain, form, as they proceed, a structure impervious to rain, and inaccessible to the wild-cat, raccoon, or fox.

Audubon drew bats (two reproduced in Boehme 2000:108–109 and five in Mearns and Mearns 2007:141), but *Viviparous Quadrupeds* omits bats and marine mammals. Bachman wanted to include both groups but Audubon refused (Peck 2000:107). Although Bachman's text was reliable, the illustrations lacked the vivid colors and liveliness of Audubon's bird illustrations, and *Viviparous Quadrupeds* never achieved the popularity of *Birds of America*.

John Richardson (1789–1865) was a surgeon in the British Navy who studied for an M.D. degree at Edinburgh, and while there, studied natural history under Professor Robert Jameson. As surgeon and naturalist, he explored northern Canada with Sir John Franklin, 1819–1822 and 1824–1827, who was in quest of a northwest passage to China (Johnson 1976a, b, McNicholl 1997, Bown 2002:172–194, Johnson and Johnson 2004). The first expedition suffered hardships, the second went smoothly. During his extensive travels, Richardson observed and collected

mammals, birds, fish, insects, vascular plants, lichens, and geological specimens. Those observations and specimens became the basis, first, for three appendices to Franklin's *Narrative of a Journey to the Shores of the Polar Sea in the Years 1819, 20, 21 and 22* (1823) on geology, fishes, and plants (Richardson 1823a, b, c); Joseph Sabine (1770–1830) wrote an appendix on Richardson's mammals and birds (1823, 1974). Second, Richardson used his collections and notes for his own *Fauna-Boreali-Americana: or the Zoology of the Northern Parts of British America* (1829–1837), in which he alone wrote the volumes on mammals (1829) and fishes (1836), and he collaborated with William Swainson on the volumes on birds (1831) and insects, the latter also with collaborator William Kirby (1837). When the editor of *The Canadian Entomologist* discovered that there were only two copies of Volume 4 in Canada, he began reprinting Kirby's contribution to that volume in his journal (Kirby 1870). Richardson's great work (all four volumes reprinted, 1978) effectively superseded Thomas Pennant's *Arctic Zoology* (two volumes + supplement, 1784–1887, edition 2, 1792), on Canadian mammals and birds, compiled without Pennant ever having seen Canada. Richardson's bibliography (Curvey and Johnson 1969, Huntley et al. 1972) shows he was a disciple of Humboldt, for he collected and published data on climate and vegetation at Hudson's Bay (1825), the Aurora Borealis (1828), topography and geology (1834), permafrost (1839), and on how to collect Arctic air temperature data (1839). Richardson's journal for the period, 21 August 1820 to 19 December 1821, survives and is now published (Richardson 1984). Its editor, Stuart Houston, provides six appendices of his own, which discuss Richardson's observations and collections on birds, mammals, fishes, vascular plants, lichens, and geology (in Richardson 1984:223–316).



Fig. 9. John Richardson. Johnson 1976a.



Fig. 10. Barren ground caribou *Rangifer tarandus*, var. *arctica*. Richardson 1829–1837, I:240.

At Fort Enterprise, on 9 October 1820, Richardson recorded extensive notes on caribou, an American subspecies of *Rangifer tarandus*, and how the Copper Indians hunted it, of which this is a sample (Richardson 1984:15–17)

The Rein-deer have been very numerous in this neighborhood for 15 or 20 days past. Their horns, which in the middle of August were yet tender, have now attained their proper size and are beginning to lose their hairy covering which hangs from them in ragged filaments. The fat is at this season deposited to the depth of two inches or more on the rumps of the males and is beginning to get red and high flavoured, which is considered as an indication of the commencement of the rutting season. The horns of the Rein-deer vary not only with its sex and age, but are otherwise so uncertain in their growth that they are never alike in any two individuals. The females and young males have shorter and less palmated horns and generally want a broad plate which runs forward betwixt the eyes and hangs over the nose in the older males.... Towards the spring the larvae of the oestrus [fly] attaining a large size, produce so many perforations in the skins that they are good for nothing. The cicatrices only of these holes are to be seen in August, but a fresh set of ova have in the mean time

been deposited.

The Rein-deer retire from the sea-coast in July and August, rut in October on the verge of the barren grounds and shelter themselves in the woods during the winter.

The entire account was quoted in Franklin's *Journal* (1823:243–244) and in Richardson's *Fauna Boreali-Americana*, Volume I: *Quadrupeds* (1829:238–249, Fig. 10).

The plants collected by Richardson and Thomas Drummond (about 1790–1835) on the Franklin expedition were the main resource for William Jackson Hooker's *Flora Boreali-Americana* (two volumes, 1833–1840), that complemented the zoological works. Richardson's and Hooker's volumes were the first scientific publications subsidized by the British government, a welcome precedent for Charles Darwin, whose government-supported *Beagle* volumes soon followed. In 1845 Franklin led a third search for a Northwest Passage, and when he and 134 men failed to return, Richardson became co-leader of the first rescue expedition in 1847–1849. After 38 attempts, their remains were discovered in 1859 (Beattie and Geiger 1988, Beardsley 2002).

Alexander Philip Maximilian, Prince of Wied-Neuwied (1782–1867), followed Humboldt's example of using aristocratic wealth to fund natural history expeditions to both Brazil (1815–1817) and to the North American West (1832–1834) (Thomas 1976). On his North American expedition he was accompanied by German hunter–taxidermist David Dreidoppel, a veteran of the Brazilian expedition, and Swiss artist Karl Bodmer (1809–1893). Theirs was “one of the most important explorations ever made of the upper Missouri region” (Schwarz 1997c:513). They arrived in Boston on 4 July 1832, and soon traveled to Philadelphia and visited Peale's museum. Titian Peale told Maximilian about Say and Lesueur at New Harmony. They traveled there on their way west, arriving in October (Maximilian 1905, XXII:162, 1966, Stroud 1992:245–250). Maximilian fell sick, and when he recovered, Dreidoppel came down with the same ailment; they spent the winter there, where Bodmer painted a portrait of Lesueur, who resembled a pioneer hunter, with a long beard (Hamy 1968: frontispiece).

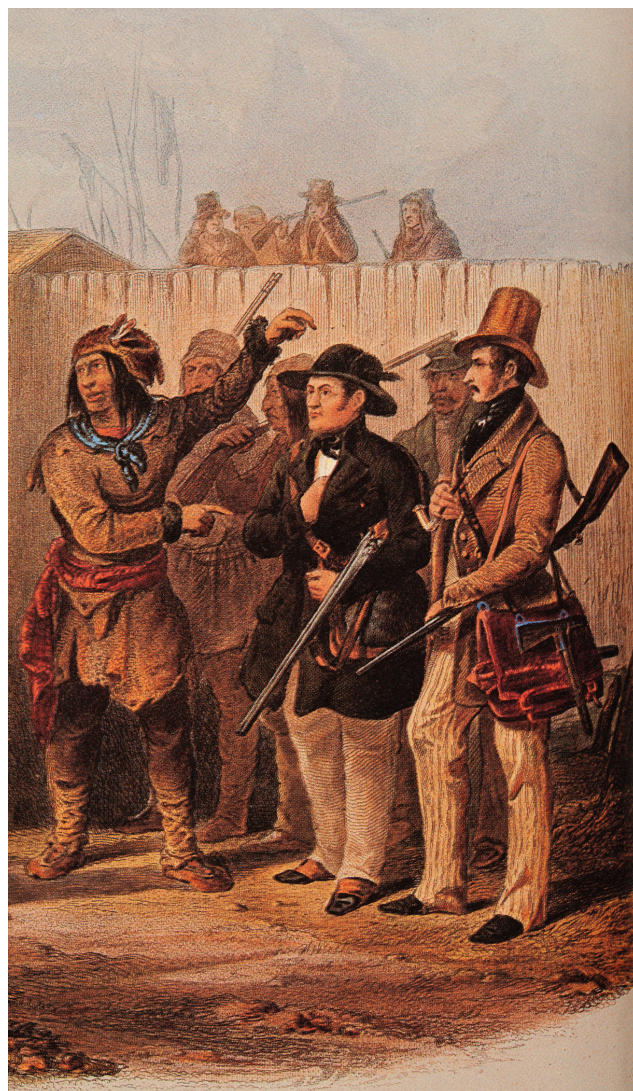


Fig.11. Alexander Philip Maximilian (center), Karl Bodmer, and David Dreidoppel (in rear), being introduced to Minnetaree Indians (not shown here) by the explorers' interpreter, Toussaint Charbonneau, at Fort Clark, along the Missouri River, June 1833. By K. Bodmer.

In mid-March they continued their journey westward, and on 10 April 1833, they boarded the American Fur Company's steamboat, *Yellowstone*, to ascend the Missouri River to Fort McKenzie, near modern Great Falls, Montana, before returning downriver to Fort Clark for the winter (Maximilian 1905, 1966, Davidson 1963, Sprague 1967:33–65, Thomas and Ronnefeldt 1976, Bown 2002:94–120). Maximilian was a close observer, and Bodmer's pictures of landscapes, plants, animals, and Indians were equally valuable: "Exacting attention to detail reflects skill of close observation gained from training as draftsman and makes Bodmer's works reliable historical documents and remarkable art" (Schwarz 1997a:89).

Since they spent more time at Fort Clark than anywhere else except New Harmony, they had time to make a kind of Humboldtian survey of the area's climate, plants, animals, and Indians. Here is a sample (Maximilian 1905:XXIII, 238)

At the Mandan villages, the leaves of the plants seldom appear before May; the willows on the banks, perhaps, a little sooner. The flowers in the prairie are said not to blossom earlier; and in some years the trees have not been clothed with foliage till the end of May. The changes of temperature are often sudden and unpleasant. The summer is always dry and hot, yet the heat is not so enervating as on the Mississippi, though, in the prairies, when there is no wind stirring, it is excessively oppressive. Swarms of mosquitoes are a great torment in the summer time, but not in the same degree every year. Last summer they were not very numerous. We were assured that July is the only month in the year which is without frost; before and after it there are frosts nightly. In the heat of summer the creeks become dry, and the crops of maize of the Indians often fail in consequence of drought.

McKelvey (1955:522–558) gives a good summary, mainly extracts, of Maximilian's natural history, particularly concerning plants (see also Stafleu and Cowan 1976–1988, III:381).

On their return trip, some of their plant and animal specimens were lost in a river accident. They stopped again at New Harmony to tell their friends about their adventures and discoveries and to show Bodmer's illustrations. Like Humboldt, Maximilian was very conscientious about taking notes during his two expeditions and then writing travel memoirs, with scientific observations based on the notes. His Brazilian memoirs were in two volumes, 1820–1821, followed by a natural history of Brazil, four volumes in six, 1825–1833 (Thomas 1976). His memoirs on his American West expedition were in two volumes plus atlas, 1839–1841 (English, 1843, 1905, 1966, abridged text in Thomas and Ronnefeldt 1976). A meteorological table for forts Clark and Union in the German edition is only summarized briefly in the 1905 and 1966 editions, followed by a bird calendar and list, and plant lists (1905, XXIV: 318–346). Maximilian's catalog of reptiles observed and collected on his western expedition (1865) is reprinted by Adler (1978b, Volume 2).

We left Thomas Nuttall (1786–1859) at the Harvard Botanic Garden (Egerton 2009:459–461), where he stayed a decade, traveling widely from there (Stuckey 1997:582). Besides plants, he was interested in birds. His closest friend in Cambridge was James Brown (1800–1855), co-founder of a publishing house, who was also interested in birds. Brown told Nuttall there was no inexpensive guide to American birds and suggested he write one. Nuttall agreed, and spent at least two months in Philadelphia in early 1829

studying Wilson's specimens at the Peale Museum. He made his own observations and studied the works of Wilson, Bonaparte, and Audubon before publishing in January 1832 *A Manual of the Ornithology of the United States*, Volume 1: *The Land Birds*, which book sold well (Graustein 1967:237–250). Neither Audubon nor Nuttall saw the other as a competitor. Audubon came to Boston in August with a letter of introduction from Richard Harlan, and they became friends. Nuttall provided specimens of three species which Audubon drew for *Birds of America*, without acknowledging their source (Graustein 1952:84). However, Audubon compensated for that slight by naming two species for Nuttall (Mearns and Mearns 1992:335–346). Nuttall had begun work on aquatic birds by October 1831 and published *The Water Birds* in 1834, which Audubon thought inferior to *The Land Birds* and never achieved the popularity of the latter (Graustein 1952:85).

James Brown introduced Nuttall to his close friend, Nathaniel Jarvis Wyeth (1802–1856), who also became Nuttall's friend (Graustein 1967:237–238, Savage 1979:182–186). Wyeth made two commercial trips over the Oregon Trail to the Pacific (Spence 1999). He invited Nuttall to go on his second trip in 1834, and Nuttall resigned his position at Harvard. Nuttall then invited John Kirk Townsend (1809–1851), a Philadelphia ornithologist (Beidleman 1957, Ewan and Ewan 1981:222–223, Evans 1993:205–208, Simpson 1999, Bown 2002:153–171, Mearns and Mearns 2007), to come along. Nuttall did not publish an account of their adventures, but Townsend did (1839); there are several modern editions of Townsend's *Narrative*, the most useful being in Mearns and Mearns' magnificent biography (2007:29–265). McKelvey (1955:586–626) and Beidleman (2006:134–141) described the trip using Townsend and other sources. Townsend sent 93 bird skins to the Academy of Natural Sciences, where Audubon studied them. He and Nuttall described them in an article they attributed to Townsend and named a species for him (Mearns and Mearns 1992:447–459, 2007:11–12, Fischer 2001:19–20). Back home, Townsend used arsenic powder to preserve animal specimens and died of accidental poisoning. In California, Nuttall collected plants from Monterey south to San Diego in March–May 1836 (Coville 1899:111). Nuttall published eight articles on plants found on this journey (listed in MacPhail 1983b:18–19). Nuttall's return to the east was by ship around Cape Horn. On that ship, *Alert*, was a crewman who had gone to Harvard, Richard Henry Dana (1815–1862), who recognized Nuttall and described him in his famous book, *Two Years before the Mast* (1840, Chapter 32; quoted in Graustein 1967:316–317, Fischer 2001:21–22). Back in Boston in 1836, Nuttall made available to Audubon five or six unknown birds, with promise of more (Graustein 1952:88). Nuttall had also collected notes and leaves from trees seen on his trip, and he wrote three volumes of *The North American Sylva* (1842–1849) on trees omitted from F. A. Michaux's three volumes with the same title—an important work that did for trees what Bonaparte had done for birds in his continuation of Wilson's work (MacPhail 1983b:6–16). The first American ornithological organization was the Nuttall Ornithological Club, founded in Cambridge, Massachusetts (1873) and still active (Kastner 1986:17–29, Barrow 1998:47–50).

Dana's *Two Years before the Mast* was just one of several books being written about western adventures. Washington Irving (1783–1859) was a successful author who lived in Europe, 1815–1832, and soon after returning accompanied Indian Affairs Commissioner Henry Ellsworth on a month's tour into Indian country (Hedges 1999). That experience was the basis for Irving's *A Tour on the Prairies* (1835). His book prompted John Jacob Astor (1763–1848) to give Irving access to his own records to write a history of the western fur trade, *Astoria* (1836), which also mentioned Nuttall and John Bradbury's 1811 overland trip with the Astorians (Irving 2004, Chapter 15: 295–296). These two books,



Fig. 12. Male pronghorn (*Antilocarpa americana* Ord), collected by David Dreidoppel, illustrated by Karl Bodmer (Maximilian 1905, XXIII:247, 1966, Thomas and Ronnefeld 1976:166).

in turn, led Benjamin Louis Eulalie de Bonneville (1796–1878) to provide Irving with notes from his explorations, May 1832–July 1835 (Parman 1999). Bonneville had requested leave from the U.S. Army, and his request had a Jeffersonian ring to it, as indicated in the official response (Irving 2004:955)

The leave of absence which you have asked...to carry into execution your design of exploring the

country to the Rocky Mountains and beyond, with a view of ascertaining the nature and character of the several tribes of Indians inhabiting those regions: the trade which might be profitably carried on with them: the quality of the soil, the productions, the minerals, the natural history, the climate, the geography and topography, as well as geology of the various parts of the country within the limits of the territories belonging to the United States, between our frontier and the Pacific...has been sanctioned.

Irving published *The Adventures of Captain Bonneville* in 1837. These books are available in a modern edition: *Three Western Narratives* (Irving 2004). Francis Parkman (1823–1893) was a Harvard-educated lawyer turned historian (Gale 1999). In the summer of 1846 he traveled west to Fort Laramie, in what is now Wyoming, and wrote *The Oregon Trail*, that appeared in *Knickerbocker* magazine, 1847–1849, then appeared as a best-selling book in 1849. It also is available in a modern edition (Parkman 1991). These travelogues contain observations on bison, prairie dogs, and other natural history topics, which encouraged popular interest in the more specialized works by naturalists.

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