

**THE EARLIEST DISCOVERIES OF ARTICULATED FOSSIL FISHES
(ACTINOPTERYGII) IN THE UNITED STATES:
A HISTORICAL PERSPECTIVE**

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ABSTRACT. The first articulated fossil fishes (Actinopterygii) unequivocally discovered in the United States were collected in the Early Jurassic lacustrine deposits of the Newark Supergroup. They were reported in 1816 by Benjamin Silliman (1779–1864), the founder of the *American Journal of Science*, in Parker Cleaveland (1780–1858)'s *Elementary treatise on mineralogy and geology*. These fossils were found in Westfield, near Middletown, Connecticut. Shortly thereafter, Edward Hitchcock (1793–1864) also reported the discovery of fossil fishes in Sunderland, Massachusetts. Up to now, these specimens seemed to be lost or impossible to pinpoint in American museums. Some of them also found their way to France. In October 1818 and August 1821, Silliman sent several of these fossil fish slabs to the French geologist Alexandre Brongniart (1770–1847). Searches in French institutional paleontological collections that hold scattered parts of Brongniart's collection made it possible to rediscover these historical fossils that went completely unnoticed so far. A specimen, identified as *Redfieldius* sp., from Westfield (Hartford Basin, Connecticut), is one of the very first authenticated fossil bony fishes ever reported in the United States. Eight slabs with "ichthyolites" (fossil fishes) collected in Sunderland (Deerfield Basin, Massachusetts) by Edward Hitchcock in or before April 1821 have also been rediscovered. Three of them contain type material (lectotype and paralectotype) of *Semionotus fultus* (Agassiz, 1833), the first scientifically named fossil fish from the Newark Supergroup. The other five slabs contain *Semionotus* sp. and *Semionotus tenuiceps* (Agassiz, 1835). This paper presents the historical context surrounding these early discoveries in the light of the correspondence between Hitchcock, Silliman and Brongniart. This study highlights an early example of transatlantic scientific exchange in geosciences at the beginning of the nineteenth century.

Key words: History of paleontology, Benjamin Silliman, Edward Hitchcock, Alexandre Brongniart, Louis Agassiz, Newark Supergroup, Early Jurassic, Actinopterygii, *Semionotus*, *Redfieldius*

ABBREVIATIONS

| | |
|------|---|
| ACM | Beneski Museum of Natural History, Amherst College, Amherst, Massachusetts |
| AEN | Archives de l'Etat de Neuchâtel, Suisse |
| ALS | Autograph Letter Signed |
| AN | Autograph Note (not signed) |
| APS | American Philosophical Society, Philadelphia, Pennsylvania |
| BCL | Bowdoin College Library, Brunswick, Maine |
| BCM | Bibliothèque Centrale du Muséum National d'Histoire Naturelle, Paris, France |
| EOH | Edward and Orra White Hitchcock Papers, Archives and Special Collections, Amherst College Library, Amherst, Massachusetts |
| MNHN | Muséum National d'Histoire Naturelle, Paris, France |
| NYL | New York Public Library, New York |
| UPMC | Paleontological collection, Université Pierre et Marie Curie (Pierre and Marie Curie University), Paris, France |
| YPM | Yale Peabody Museum of Natural History, New Haven, Connecticut |
| YUL | Yale University Library, New Haven, Connecticut |

INTRODUCTION

History of vertebrate paleontology in North America is well documented with regard to large animals, such as proboscidiens or dinosaurs, to name but a few (Simpson, 1942, 1943; Weishampel and Young, 1996; Hedeon, 2008). Fossil shark and ray teeth are also notably some of the first fossil vertebrates discovered in North America (Ray, 2001) and are reported in the literature since the end of the seventeenth century (Sloane, 1697; Petiver, 1705, p. 1960; Scheuchzer, 1708, p. 20, pl. 3; Woodward, 1728, p. 23–25, 27; Latrobe, 1799; Mitchill, 1815, p. 483; Gaudant and Bouillet, 2008, p. 65). The Newark Supergroup deposits of eastern North America (Late Triassic-Early Jurassic) yields one of the most extensive sequences of early Mesozoic continental fossil assemblages (Olsen, 1988). The earliest authenticated record of dinosaur footprints in North America is amongst the most historically significant discoveries from these deposits. The discovery occurred in 1802 when a teenager named Pliny Moody ploughed up, on his family's farm in South Hadley, Massachusetts, a slab of red sandstone bearing three-toed footprints. It was however reported in literature much later (Hitchcock, 1836, p. 322; 1844, p. 297; 1858, p. 3, 194; McDonald, 1982, p. 145; Steinbock, 1989; Pemberton and others, 2007). In addition, the earliest verified skeletal remains of a North American dinosaur were also found in the Newark Supergroup sedimentary rocks (Weishampel and Young, 1996, p. 56–58). In 1818, during the blasting of a well near Ketch's Mills, in East Windsor, Connecticut, bone fragments were discovered by Solomon Ellsworth Jr. in the Early Jurassic red sandstones of the Portland Formation. They were reported in 1820 by Nathan Smith (1762–1829) in the *American Journal of Science* (Smith, 1820). First supposed to be human bones (Smith, 1820) or remains of a large animal (Silliman, 1820; Hall, 1821; Wyman, 1855), they will be later identified as a right forelimb, vertebrae and a left femur of Plateosauria (Lull, 1912, p. 411; Galton, 1976). They are now housed in the Yale Peabody Museum of Natural History (YPM VP.002125).

Actinopterygian fish are the most common and diverse elements of the Newark vertebrate fauna. They have been the subject of extensive study during the last forty years (McDonald, ms, 1975; Schaeffer and McDonald, 1978; Olsen and others, 1982; McCune and others, 1984; McCune, 1987; Olsen and McCune, 1991), and give important insight into speciation process in lacustrine environment (McCune, 1996, 2004). The earliest mention of fossil fishes from the Newark Supergroup, and even more generally from the United States, can be found in a short note by Benjamin Silliman (1779–1864) (fig. 1A) published in December 1816 (McDonald, 1982, 1996; Brignon, 2014). Having in mind that the South Hadley dinosaur footprints discovered in 1802 were not described in the literature until 1836, Silliman's note is also the first published mention of a Newark fossil vertebrate. Silliman played a leading role in the foundation of a collection of rocks and minerals in Yale (Narendra, 1979). The growing collection was housed in the Cabinet building from 1820 until 1876, when the newly created Peabody Museum was ready to receive it. Silliman is also celebrated as the founder of the *American Journal of Science*, the longest-running scientific journal in the United States having been published continuously since 1818. After the pioneering works of the Swiss-born zoologist and geologist Louis Agassiz (1807–1873), recognized as the father of paleoichthyology, and his first scientific descriptions of fossil fishes from the Connecticut Valley, many Newark fish species were described and named during the nineteenth and beginning of the twentieth centuries by John Howard Redfield (1837), William Charles Redfield (1841), John Strong Newberry (1888), George Francis Eaton (1903), and Charles Rochester Eastman (1905). Despite the relative abundance of fossil fish in the Newark deposits, the history of their earliest discoveries has been however

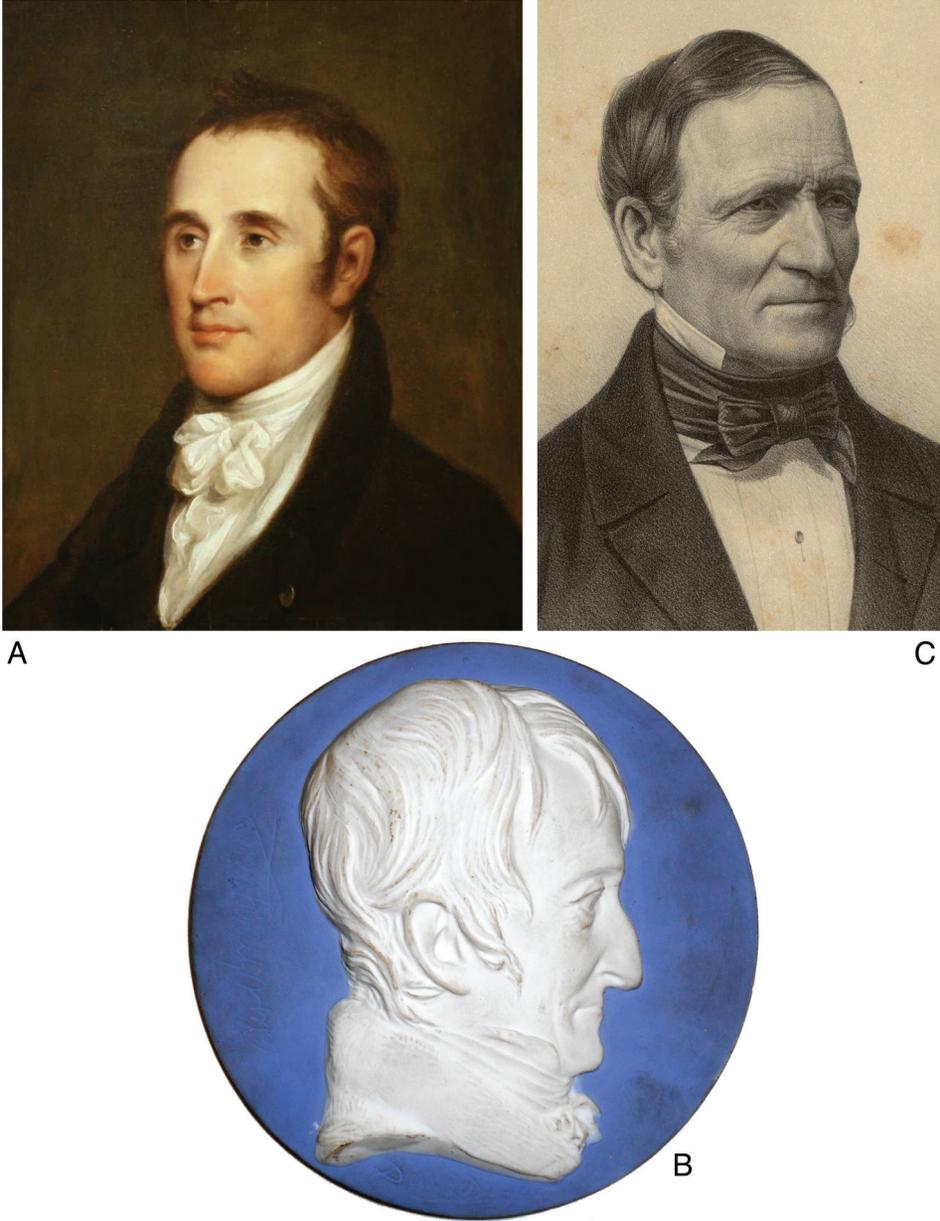


Fig. 1. (A) Benjamin Silliman (1779–1864), oil on wood by John Trumbull (1756–1843), 1825, size of the panel: 48.9 × 40 cm; National Portrait Gallery, Smithsonian Institution, Washington, DC; gift of Alice Silliman Hawkes, 1968 (NPG.68.6). (B) Alexandre Brongniart (1770–1859), plaster medallion by Pierre-Jean David d'Angers (1788–1856), 1846, 17 cm in diameter; private collection. (C) Edward Hitchcock (1793–1864), lithograph, *circa* 1854, 20 × 11 cm; Edward and Orra White Hitchcock Papers (Box 24, Folder 5), Amherst College Archives & Special Collections.

overlooked. The first historical specimens seemed to be lost or impossible to pinpoint in American museums. Lack of contemporary collection catalogs or informative labels affixed to specimens are the main causes of this difficulty.

Some of these fossils can, however, be tracked to France. From the second half of the eighteenth century, French scientists were taking a keen interest in North American fossils (Taylor, 1990). Notably, Alexandre Brongniart (1770–1847) (fig. 1B) was seeking to obtain specimens to establish possible correlations between geological formations in Europe and America. Brongniart is a renowned French geologist who contributed with his colleague Georges Cuvier to establish the principles of stratigraphic paleontology during the first decades of the nineteenth century (Cuvier and Brongniart, 1808, 1811). Brongniart was a major influence on the pioneers of American mineralogy and geology such as Parker Cleaveland (1780–1858), professor at the Bowdoin College, Brunswick, Maine, and Benjamin Silliman. Cleaveland's *Elementary Treatise on Mineralogy and Geology* (1816) was substantially based on concepts and classifications presented in Brongniart's treatise published in 1807 (Bork, 1999). As another illustration of Brongniart's stature and scientific reputation, Silliman contacted Brongniart in 1818 to ask his opinion concerning American rocks, minerals and fossils, in particular those collected in what will be later identified as the lacustrine deposits of the Newark Supergroup (Al. Brongniart and Silliman, 1821, p. 216). From then on, the two men became correspondents, not only sharing ideas but also exchanging specimens (Bork, 1999). Professor at Yale, Silliman enjoyed a respectable and privileged position which enabled him to establish an efficient network of local fossil collectors, including notably Edward Hitchcock (1793–1864) of Deerfield, Massachusetts (fig. 1C). Silliman obtained quickly a wealth of specimens intended to be forwarded to his French colleague. Many of the very first fossil fish collected in Connecticut and Massachusetts were thus sent to Alexandre Brongniart in Paris. Searches in French institutional paleontological collections that holds scattered parts of Brongniart's collection made it possible to rediscover these historical fossils that went completely unnoticed so far. The aim of this paper is to present these specimens for the first time and the historical context surrounding these discoveries of the utmost importance for the history of American paleontology.

EARLY DISCOVERIES OF FOSSIL FISHES IN THE NEW WORLD, AND MORE PARTICULARLY IN THE UNITED STATES, UNTIL THE 1820S

The earliest allusion to a presumed fossil bony fish from the New World can be found in the correspondence between Joseph Lord (1672–1748) and James Petiver (c. 1663–1718), a rich London apothecary who amassed a large natural history collection (Smallwood and Smallwood, 1941, p. 88). Joseph Lord was living in Dorchester, South Carolina and was one of several individuals in the British colonies of North America who agreed to collect natural history specimens for Petiver (Stearns, 1952; Sanders and Anderson, 1999; Blackwell and McMillan, 2013). In a letter dated 1 September 1707, Joseph Lord told of a tail of a small fish with distinguishable fins and scales in a flat piece of stone found in "a part of [his] land" (Ray, 2001). Lord's letter reveals that the fish was sent to Petiver. After Petiver's death, the naturalist and collector Hans Sloane (1660–1753) purchased the latter's collection (Thackray, 1994). If the specimen had survived, it should have been in Sloane's cabinet of natural history. A significant proportion of this collection was later to become the foundation for the Natural History Museum in London but Joseph Lord's presumed fossil fish has not as yet been recognized in the collections of this museum (Ray, 2001).

In March 1755, a fossil fish (Perciformes, Menidae) from the Oligocene of Antigua, British West Indies, was mentioned by Francis Byam (1709–1757) in a letter to William Fauquier (Byam, 1756; Eastman, 1914, p. 346–347; Stearns, 1970, p. 348–349). The specimen was offered to Arthur Pond (1701–1758) and was figured in the Philosophical Transactions of the Royal Society of London (Pond, 1756). Byam's letter and accompanying plate is the earliest published account and illustration of an articulated fossil fish from the New World. Based on this illustration, Charles Rochester

Eastman (1914) erected a new species, *Mene novaehispaniae* (Friedman and Johnson, 2005). Another early record of fossil fish from the New World, supposed to be the first allusion to the Cretaceous fish nodules from the Santana Formation in Ceará, Brazil, can be found in a letter written in December 1800 by the Portuguese naturalist João da Sylva Feijoo (1760–1824), born in Rio de Janeiro (Antunes and others, 2005). After his travel through Latin America, the Prussian geographer, naturalist, and explorer Alexander von Humboldt (1769–1859) mentioned fossil fishes from Ceará and from the region of Pasco in central Peru (Humboldt, 1822, p. 265; 1823, p. 240; 1825a, p. 169; 1825b, p. 229, footnote 5; Brignon, 2014, p. 245). Fish nodules from the Santana Formation were also collected by the Bavarian zoologist Johann Baptiste von Spix (1781–1826) and the botanist Carl Friedrich Philipp von Martius (1794–1868) during their scientific expedition in Brazil between 1817 and 1820 (Maisey, 1991, p. 12–14; Kellner and Campos, 1999; Martill, 2007). The first published figure of a Brazilian specimen, possibly of the genus *Rhacolepis* Agassiz, 1841, is given in the second volume of their work, *Reise in Brasilien* [Travel in Brazil] (Spix and Martius, 1828, pl. 22, fig. 5, p. 799).

The first unquestionable record of fossil bony fish from the United States was reported during the Lewis and Clark Expedition of 1803–1806. The exploration was commissioned by President Thomas Jefferson principally to determine the practicality of a commercial route from the Mississippi River to the Pacific Ocean. Meriwether Lewis (1774–1809) and William Clark (1770–1838) were appointed to command the Corps of Discovery. On 6 August 1804, an upper-jaw fragment with teeth of what will be later identified as an ichthyodectiform fish was collected from Cretaceous strata in present day Harrison County, Iowa (Simpson, 1942, p. 169–170; Spamer and others, 2000, p. 51). The specimen was later named *Saurocephalus lanciformis* by Richard Harlan (1824). However, it was originally misidentified as the jaw of a marine “saurian” (Everhart, 2005, p. 75). It is the only fossil which survives from the Lewis and Clark Expedition and is currently in the collection of the Academy of Natural Sciences of Philadelphia (ANSP 5516).

The earliest mention of articulated fossil fish from the Newark Supergroup can be found back to 1816 in a short notice by Benjamin Silliman published in Parker Cleaveland (1780–1858)’s *Elementary treatise on mineralogy and geology* (Cleaveland, 1816, p. 174, 363). Silliman reported the presence of fish impressions at Westfield near Middletown, Connecticut. As he later wrote: “*the person who brought*” the fishes, “*obtained them at the depth of about 40 feet, while exploring for coal, four miles west of Middletown: he brought his chaise box full of them to New-Haven*” (Al. Brongniart and Silliman, 1821, p. 221). These specimens came from the Early Jurassic lacustrine Westfield Bed of the East Berlin Formation within the Hartford Basin (Davis and Loper, 1891; Schaeffer and McDonald, 1978, p. 166–167; LeTourneau and others, 2015). Fossil fish deposits of the Basin are found primarily in organic-rich microlaminated black shales cyclostratigraphically associated with periods of lake highstand (Hubert and others, 1976; Olsen, 1986; Leonard, ms, 2013). Silliman’s notice on fossil fishes from Westfield was also reported in the second edition of Amos Eaton (1776–1842)’s *Index to the geology of the northern states* (Eaton, 1820, p. 163) and in Frederick Hall (1780–1843)’s *Catalogue of minerals found in the State of Vermont and in the adjacent states* (Hall, 1824, p. 39). Richard Harlan (1834, p. 92) also mentioned “*a fine collection of fossil fishes in the slate from Westfield, Connecticut*” received from the geologist Augustus Edward Jessup (1795–1859). Two of these specimens were donated by Harlan to the Museum of the Academy of Natural Sciences in Philadelphia in September 1826 (Anonymous, 1827, p. 397).

In 1818, several mentions of fossil fishes from other localities within the Newark Supergroup were reported (table 1). Samuel Latham Mitchill (1764–1831) mentioned that “*impressions or forms of fossil fish*” were collected in the town of Glastonbury,

TABLE 1

First articulated fossil fishes discovered in the 1810s and the 1820s in the United States

| Date of discovery | Year of publication | Name of discoverer | Locality | Basin | Reference |
|-----------------------------|---------------------|--------------------|----------------------------------|-----------------|--|
| In or before 1816 | 1816 | B. Silliman | Westfield, Middletown, CT | Hartford Basin | Cleaveland, 1816, p. 174, 363; 1822, p. 186, 451; Silliman, 1818; Eaton, 1820, p. 163; Al. Brongniart and Silliman, 1821; Al. Brongniart and others, 1822; Hitchcock, 1823a, p. 76; 1823b, p. 212; 1825, p. 39; Hall, 1824, p. 39; Cuvier, 1824, p. 309; Robinson, 1825, p. 102; Van Rensselaer, 1825, p. 357; De Kay, 1826, p. 55; Comstock, 1827, p. 98; Anonymous, 1838 |
| In or before October 1817 | 1818 | E. Hitchcock | Whitmore's Ferry, Sunderland, MA | Deerfield Basin | Hitchcock, 1818, p. 110; Eaton, 1820, p. 215 |
| In or before January 1818 | 1818 | J. Grammer Jr. | Heth's coal pits, Midlothian, VA | Richmond Basin | Grammer, 1818 |
| In or before 1818 | 1818 | M. Bruen | Glastonbury, CT | Hartford Basin | Mitchill, 1818a, p. 365; 1818b, p. 69-70; 1826, p. 18 |
| April 1821 | 1821 | E. Hitchcock | Whitmore's Ferry, Sunderland, MA | Deerfield Basin | Al. Brongniart and Silliman, 1821; Silliman and Hitchcock, 1821; Al. Brongniart and others, 1822; Hitchcock, 1823a, p. 76-77; 1825, p. 39; Hall, 1824, p. 39; Silliman, 1829, p. 123 |
| In or before September 1822 | 1823 | ? | West Springfield, MA | Hartford Basin | Hitchcock, 1823a, p. 76 |
| In or before September 1825 | 1826 | E. Davis | West Springfield, MA | Hartford Basin | Davis, 1826, p. 215 |
| In or before September 1826 | 1827 | A. E. Jessup | Westfield, Middletown, CT | Hartford Basin | Anonymous, 1827, p. 397; Harlan, 1834, p. 92 |
| In or before September 1827 | 1828 | L. Smith | Southbury, CT | Pomperaug Basin | Hitchcock, 1828, p. 228; Silliman, 1835, p. 354 |

All specimens were collected in the Late Triassic-Early Jurassic lacustrine deposits of the Newark Supergroup.

Connecticut (Mitchill, 1818a, p. 365; 1818b, p. 69–70). Though the specimens were broken, tail, scales, and fins were perfectly distinguishable according to Mitchill. The fish remains were contained in a “*black bituminous shist interspersed with fine particles of mica*”, corresponding to the typical micaceous black shales exposed in the Hartford Basin. This discovery was made by reverend Matthias Bruen (1793–1829). Mitchill (1826, p. 18)’s collection of “organic remains” included two of these specimens. He donated his collection to the New York Lyceum of Natural History in August 1826, but it was destroyed by fire on 21 May 1866 (Barnhart, 1917; Cleevely, 1983, p. 205). In a letter to Benjamin Silliman dated 28 January 1818, John Grammer Jr. reported an “*impression of a fish*” found in John Heth (1798–1842)’s coal pits situated in the present Midlothian area of Chesterfield County within the Richmond Basin, Virginia. This

Basin contains some of the stratigraphically oldest sedimentary rocks of the Newark Supergroup dating early Late Triassic (Sues and others, 1994). Grammer's letter was published in December 1818 in the second number of the inaugural volume of Benjamin Silliman's *American Journal of Science* (Grammer, 1818). In the same journal issue also appears the first allusion to fossil fish from the Early Jurassic of the Deerfield Basin (Hitchcock, 1818, p. 110; Olsen and others, 1992, p. 491). These observations were sent to Silliman in October 1817 by Edward Hitchcock who reported "*distinct impressions of fish*", occurring in a "*schistose rock*" on the bank of the Connecticut River, at Whitmore's Ferry, north of Sunderland. Hitchcock was a clergyman, geologist, and later professor and president of Amherst College. He established a lifelong correspondence with Silliman (Herbert, 2012). At Silliman's request and expense, Hitchcock employed men to further uncover specimens of fish at Sunderland site (Silliman and Hitchcock, 1821). Figures of Sunderland fishes were published in Hitchcock (1823a)'s "*Sketch of the geology, mineralogy, and scenery of the regions contiguous to the River Connecticut*" (fig. 2). They are the first illustrations of fossil bony fishes (Osteichthyes) from the United States. They were drawn by Edward Hitchcock's spouse, Orra White (1796–1863), one of America's earliest women scientific illustrators (Worman, 1989). Edward Hitchcock presented a Sunderland fish specimen to the Troy Lyceum of Natural History (Eaton, 1820, p. 215). The discovery of fossil fishes near Sunderland by Hitchcock was subsequently mentioned in Hall's *Catalogue of minerals* (Hall, 1824, p. 39). "Ichthyolites", or fossil fishes, were also reported from West Springfield, Massachusetts within the Hartford Basin by Hitchcock (1823a, p. 76) and by Emerson Davis (1798–1866) (Davis, 1826, p. 215). Hitchcock (1828, p. 228) was informed in September 1827 that "*impression of scales probably those of a fish*" had been found in "*bituminous limestone*" in Southbury, Connecticut during exploration for coal.

Finally, it should be noted that Tillotson Bronson (1762–1826), headmaster of the Cheshire Academy, indicated to Benjamin Silliman (1819, p. 239) that petrified "*fish and other substances, both animal and vegetable*" were found in Carboniferous deposits during the excavation of a canal in Zanesville, Ohio, in the spring of 1817. Other mentions of "*fossil fish and trees*" found in Zanesville were reported by Caleb Atwater (Cleveland, 1822, p. 511, 759) and Samuel Robinson (1825, p. 236). It is likely, however, that the remains of some of the so-called fish were fragments of fossil arborescent plants with trunks exhibiting patterns sometimes confused at that time with fish scales as outlined by Samuel Prescott Hildreth (1836, p. 36). The first eurypterid fossil ever to be mentioned in the literature was also misidentified as a fossil fish by S. L. Mitchill (1818c). The specimen was recovered from the Bertie Group (Silurian), near Westmoreland, Oneida County, New York. Mitchill interpreted the appendages on the carapace as barbels arising from the mouth of the animal. He consequently concluded that the fossil was a catfish of the genus *Silurus*. A few years later, the zoologist James Ellsworth De Kay (1825) identified the fossil correctly as an arthropod and named it *Eurypterus remipes* (Clarke and Ruedemann, 1912, p. 13).

SILLIMAN, HITCHCOCK, BRONGNIART AND THE FIRST FOSSIL FISHES FROM
THE CONNECTICUT VALLEY

Archibald Bruce (1777–1818) is one of the first American mineralogists who corresponded with Alexandre Brongniart¹. From 1798 to 1805, Bruce traveled through Europe to complete his studies and to visit the most prominent mineralogists and collectors. He returned to New York bringing an extensive mineral collection (Green and Burke, 1978; Wilson, 1994, p. 149–150). Informed that Brongniart was desirous of obtaining American minerals, Bruce forwarded a small box of specimens to him on 10

¹ NYL MssCol 565, Alexandre Brongniart to Parker Cleveland, ALS, Paris, 30 June 1817

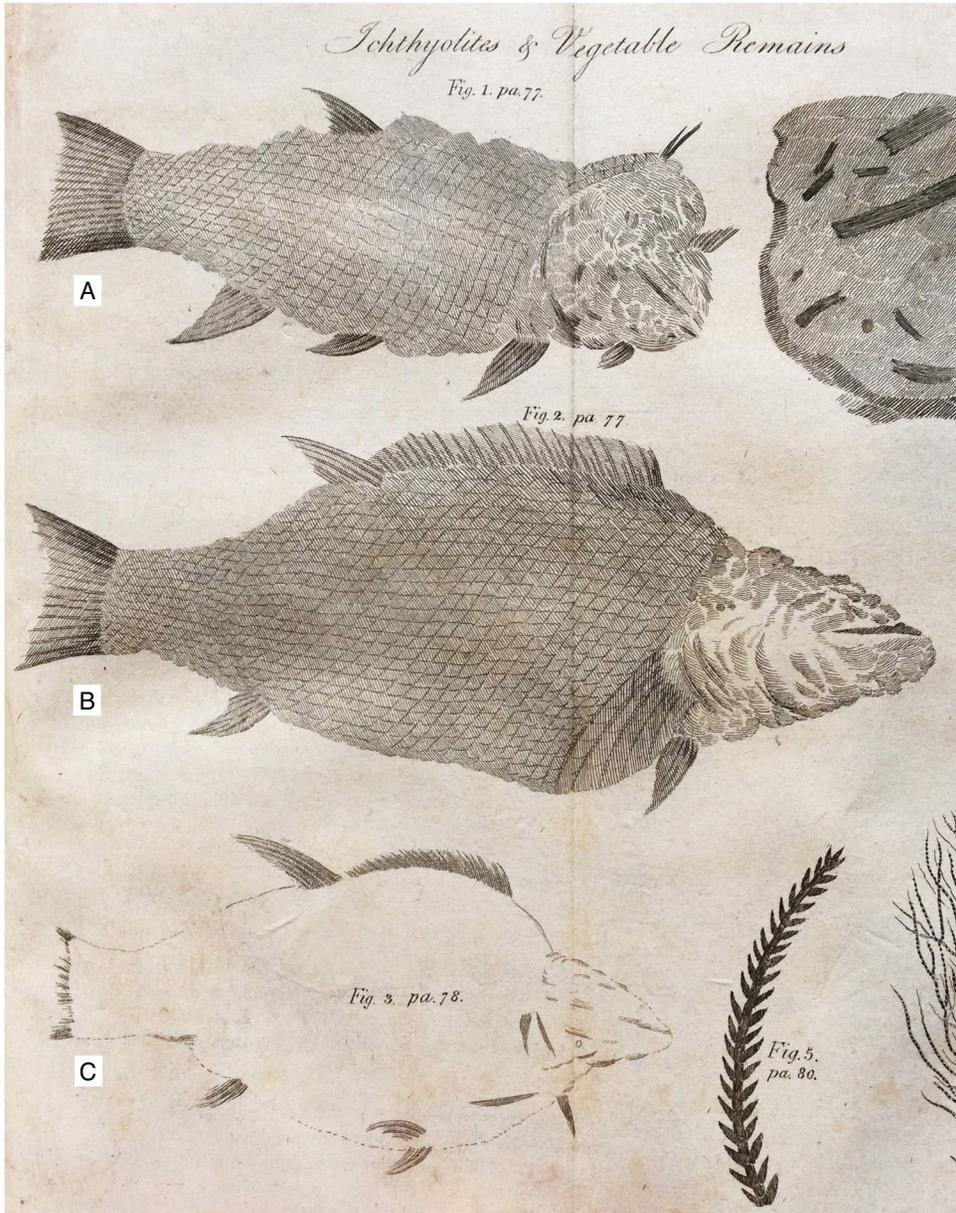


Fig. 2. First published illustrations of fossil bony fishes collected in the United States accompanying Edward Hitchcock's paper entitled "A sketch of the geology, mineralogy, and scenery of the regions contiguous to the River Connecticut" (Hitchcock, 1823a, pl. 9). These three semionotid fishes were found on the bank of the Connecticut River at Whitmore's Ferry, north Sunderland, Massachusetts. (A) paralectotype of *Semionotus fultus* (Agassiz, 1833), (B) and (C), paralectotypes of *Semionotus tenuiceps* (Agassiz, 1835). In the original plate, specimens have a length of 100 mm (A), 137 mm (B) and 94 mm (C).

July 1814 (table 2, line no. 1). In return, Brongniart assembled a collection of 50 specimens that was sent to Bruce on 30 June 1817 (table 2, line no. 2). The detailed list of them in Brongniart's hand is still kept in the Bibliothèque centrale du Muséum

TABLE 2

List of the specimens exchanged between Alexandre Brongniart (AIB), his son Adolphe (AdB), and some of their American correspondents: Benjamin Silliman (BS), Archibald Bruce (AB), Parker Cleaveland (PC), Edward Hitchcock (EH), and Jacob Cist (JC)

| Line no. | Donor and recipient | Date of shipment | Date of arrival | Content | References |
|----------|---------------------|--------------------|-----------------------|---|--|
| 1 | AB to AIB | 10 July 1814 | ? | - Small box of American minerals. | BCM Ms1965/167, AB to AIB, ALS, New York, 10 July 1814. |
| 2 | AIB to AB | 30 June 1817 | ? | - A collection of 50 specimens of minerals, rocks and fossils from various places in France and other countries in Europe. The collection included a fossil fish from the Permian of Eisleben in Germany, a caudal vertebra and a bird bone from the Priabonian of Montmartre in Paris. | BCM Ms1965/167a, AIB, AN, 30 June 1817. |
| 3 | AIB to PC | 30 June 1817 | Before 10 May 1818 | - Rocks of the "secondary formations, below the Chalk" from the vicinity of Paris. - A complete suite of rocks and minerals related to the formations of the basin of Paris and many other places in France. - A collection of fossil shells classified by formations. | NYL MssCol 565, AIB to PC, ALS, Paris, 30 June 1817; Bork, 1999. |
| 4 | PC to AIB | Before 10 May 1818 | Around 10 May 1818 | - A collection of American minerals. | NYL MssCol 565, AIB to PC, ALS, Paris, 15 June 1821. |
| 5 | BS to AIB | 16 October 1818 | Before 8 October 1819 | - Fossil fish from Westfield (collected in or before 1816, anonymous collector). - Serpentine of New-Haven. - Shales of Wilkes-Barre, Pennsylvania and Rhode-Island with fossil plants (anonymous collectors) - Fossils from Lake Ontario and Cayuga County (Oriskany Sandstone, Lower Devonian) (anonymous collectors). | YUL MS 540, Box 18, folder 19, BS to AIB, ALS, New Haven, 16 October 1818; AIB, AN, 8 October 1819; Al. Brongniart and Silliman, 1821; Wells, 1963, p. 37. |

TABLE 2
(continued)

| Line no. | Donor and recipient | Date of shipment | Date of arrival | Content | References |
|----------|---------------------|------------------|-------------------------|--|--|
| 6 | AIB to BS | 8 October 1819 | Before 28 April 1820 | <ul style="list-style-type: none"> - Collection of substances adapted to the manufacture of porcelain. - Minerals and rocks from the vicinity of Paris. - ditto from other parts of France, and from foreign countries. - 2 fossil fishes from the Permian of Europe, one from Mansfeld, Germany and one from Autun, France. | YUL MS 540, Box 18, folder 19, AIB, AN, 8 October 1819; BS to AIB, ALS, New Haven, 28 April 1820; Al. Brongniart and Silliman, 1821; Fisher, 1866, p. 283. |
| 7 | EH to BS | ? | Before 14 February 1821 | <ul style="list-style-type: none"> - Fossil fishes from Sunderland collected by EH. The specimens were intended by BS to be sent to AIB (see line no. 10). | EOH Box 3, folder 37, BS to EH, ALS, New Haven, 14 February 1821. |
| 8 | EH to BS | 10 April 1821 | Before 27 July 1821 | <ul style="list-style-type: none"> - Fossil fishes and samples of rocks from Sunderland collected by EH. These were intended by BS to be sent to AIB (see line no. 10). | EOH Box 5, folder 12, EH to BS, ALS, Deerfield, 9 April 1821; Box 3, folder 37, BS to EH, ALS, New Haven, 27 July 1821; Silliman and Hitchcock, 1821. |
| 9 | AIB to PC | 15 June 1821 | ? | <ul style="list-style-type: none"> - 102 specimens of rocks and minerals from a variety of countries and in particular from Italy. - 26 species of fossil shells from Tertiary formations. | NYL MssCol 565, AIB to PC, ALS Paris, 15 June 1821; Bork, 1999. |
| 10 | BS to AIB | 7 August 1821 | Before 23 May 1822 | <ul style="list-style-type: none"> - Fossil fishes and samples of rocks from Sunderland collected by EH (see lines no. 7 and 8). - Fossil plants from Zanesville collected by Ebenezer Granger. | YUL MS 540, Box 18, folder 19, BS to AIB, ALS, Yale College, New Haven, 7 August 1821 and 4 October 1822; Al. Brongniart, 1822. |

TABLE 2
(continued)

| Line no. | Donor and recipient | Date of shipment | Date of arrival | Content | References |
|----------|-------------------------------------|------------------|----------------------------------|--|---|
| 11 | JC (at BS's request) to AIB and AdB | 19 March 1822 | May 1822 | - 30 specimens of fossil plants from the anthracite formation of Wilkes-Barre. ⁽¹⁾ | YUL MS 540, Box 18, folder 19, BS to AIB, ALS, Yale College, New Haven, 27 September 1821 and 15 January 1822; BCM Ms1969/124a, AdB, AN, May 1822. |
| 12 | AIB to BS | 23 May 1822 | 30 September 1823 ⁽²⁾ | - Minerals. - Fossil shells. | YUL MS 540, Box 18, folder 19, BS to AIB, ALS, New Haven, 30 September 1823. |
| 13 | BS to AdB and AIB | 27 June 1823 | 1823 ⁽³⁾ | - Fossil plants from Richmond coal mines, collected by Edmund B. Wickham. ⁽⁴⁾ - Fossils from the Catskill Mountains, collected by James Pierce. ⁽⁵⁾ | BCM Ms1970/390, 392, BS to AdB, ALS, New Haven, 27 June 1823 and 11 June 1824; YUL MS 540, Box 18, folder 19, BS to AIB, ALS, New Haven, 30 September 1823; BCM Ms1967/592, James Pierce to AIB, ALS, Catskill, 25 November 1822. |

⁽¹⁾ Some of these specimens are still preserved in Adolphe Brongniart's collection held in the Muséum national d'Histoire naturelle, Paris. They bear the mention "Cist.22" on their labels referring to the name of the donor, Jacob Cist, and the year of their arrival in Paris, i.e., 1822 (see for instance MNHN.F.106, MNHN.F.130.4, MNHN.F.194, MNHN.F.364, MNHN.F.633.1, MNHN.F.727.3, MNHN.F.727.4, MNHN.F.759.1, MNHN.F.1028, MNHN.F.3434).

⁽²⁾ The box arrived in New York "during the prevalence of yellow fever, and somehow got misplaced". It was finally "discovered in the Custom House, among the rubbish of that establishment" (Bork, 1999).

⁽³⁾ Fossil plant specimens collected by Wickham, still preserved in Adolphe Brongniart's collection, are indicated as received in 1823 (see for instance MNHN.F.110.3, MNHN.F.138.2, 138.3).

⁽⁴⁾ The specimens from Richmond were injured at their arrival in Paris (NYL_MssCol 565, AdB to [BS], ALS, Paris, 10 January 1824; BCM Ms1970/392, BS to AdB, ALS, New Haven, 11 June 1824).

⁽⁵⁾ A second collection of fossil plants from Zanesville, Ohio, made by Ebenezer Granger was supposed to be forwarded to Adolphe Brongniart but was "lost in coming down the Mississippi River — the boat in which they were shipped being wrecked" (BCM Ms1970/390, BS to AdB, ALS, New Haven, 27 June 1823). See also (Silliman, 1834, p. 229).

TABLE 2
(continued)

| Line no. | Donor and recipient | Date of shipment | Date of arrival | Content | References |
|----------|---------------------|---------------------|-----------------------|---|---|
| 14 | JC to AdB | After 15 June 1824 | 1824 ⁽⁶⁾ | - Fossil plants from the anthracite formations. - Drawings of fossil plants. | BCM Ms1969, JC to AdB, ALS, Wilkesbarre, 15 June 1824. |
| 15 | BS to AIB | 15 April 1834 | Before 8 March 1836 | - Rock composed of agglutinated shells from Florida. | YUL MS 540, Box 18, folder 19, BS to AIB, ALS, Yale College, 15 April 1834; AIB, AN, 8 March 1836. |
| 16 | BS to AIB | 6 October 1836 | Before 6 January 1837 | - Specimens of two varieties of feldspar used at the porcelain manufacture of Philadelphia. | YUL MS 540, Box 18, folder 19, BS to AIB, ALS, Yale College, 6 October 1836; AIB, AN, 6 January 1837; Millasseau, 1997, p. 137. |
| 17 | EH to AIB | Before 20 July 1839 | ? | - Plaster casts and molds of fossil footprints and tracks from the Connecticut River Valley. ⁽⁷⁾ | EOH Box 5, folder 18, EH to BS, ALS, Amherst, 20 July 1839 (Herbert, 2012). |

⁽⁶⁾ A specimen of *Stigmantaria ficoides* from Wilkes-Barre still preserved in the Muséum national d'Histoire naturelle, Paris (MNHN.F.1147) is indicated as received from Gist in 1824.

⁽⁷⁾ Hitchcock also tried to send the first edition of his *Report on the geology, mineralogy, botany, and zoology of Massachusetts* (Hitchcock, 1833) to Alexandre Brongniart, but the book was returned by custom office (EOH, Box 5, folder 16, EH to BS, ALS, Amherst, 10 January 1834). At Hitchcock's request, the book accompanied by its atlas volume was finally forwarded by Silliman (YUL MS 540, Box 18, folder 19, BS to AIB, ALS, New Haven, 15 April 1834).

national d'Histoire naturelle, Paris². The collection sent to Bruce included rocks and minerals from various places in France, Italy, Spain, Switzerland, and England. Brongniart also forwarded a few fossils, notably, a caudal vertebra of *Palaeotherium* and a bird bone from Montmartre in Paris (Priabonian), and a fossil fish from the Upper Permian deposits of Eisleben in Germany.

The second American mineralogist and geologist who contacted Alexandre Brongniart was Parker Cleaveland. Just after publishing his celebrated *Elementary Treatise on Mineralogy and Geology*, Cleaveland sent a letter to Brongniart on 26 December 1816³. The two men did not know each other but Cleaveland wanted to proclaim his debt to the French geologist and to express how the *Traité élémentaire de minéralogie* (Al. Brongniart, 1807), published nine years before, had been a source of inspiration in the elaboration of his own book (Bork, 1999). Cleaveland also expressed his wish to receive specimens of minerals and rocks from France. Brongniart was very flattered by Cleaveland's letter and wrote back to him on 30 June 1817. In response of Cleaveland's request, Brongniart sent a box full of rocks collected below the Cretaceous chalk and a suite of rocks and minerals related to the formations of the basin of Paris and many other places in France (table 2, line no. 3). In addition, Brongniart supplied a collection of fossil shells classified by formation and a copy of his *Essai sur la géographie minéralogique des environs de Paris* he wrote with Georges Cuvier (Cuvier and Brongniart, 1811). He asked if Cleaveland might send some rocks of the Secondary formations and some "petrifications" from North America (Bork, 1999, p. 233). Brongniart also sent copies of a notice giving instructions on "the method of collecting, labeling and transmitting specimens of fossil organized bodies, and of the accompanying rocks". In order to render collected specimens useful for geology and scientific purpose, the most important recommendation, as stressed by Brongniart, was to clearly indicate on each specimen the place and the stratum where it had been found. The notice was intended to be distributed to Cleaveland's American colleagues. Cleaveland communicated a copy of this notice to Benjamin Silliman who published it in the first issue of the *American Journal of Science* (Al. Brongniart, 1818). In 1818, Brongniart received a set of American minerals from Cleaveland (table 2, line no. 4). He expressed his thanks to his colleague in a letter dated 15 June 1821⁴. Brongniart reported that he had studied them all, affixed labels and carefully placed them in his collection (Bork, 1999). In exchange, he forwarded several specimens of rocks and minerals from various countries and a second collection of Tertiary shells (table 2, line no. 9).

Knowing that the French geologist was looking for American "petrifications", Silliman sent a first collection of fossils and rocks to Brongniart on 16 October 1818 (table 2, line no. 5). Silliman was expecting, in turn, Brongniart's opinion on their geological significance. In the accompanying letter, Silliman wrote:

"Sir, learning from Mr Gilmor [Robert Gilmor (1774–1848)] that you are desirous of obtaining some American vegetable impressions from coal formations & learning from your printed circular that you are desirous of animal remains I have enclosed a few of both kinds & also a few specimens to illustrate a formation of marble in this vicinity".⁵

Silliman added a copy of the first number of his *American Journal of Science* and requested Brongniart's acceptance of future numbers (Bork, 1999). On 8 October 1819, Brongniart acknowledged receipt of Silliman's journal and collection of specimens. The original letter seems to be lost and only a brief summary of the letter in

² BCM Ms1965/167a

³ NYL MssCol 565, Alexandre Brongniart to Parker Cleaveland, ALS, Paris, 30 June 1817

⁴ NYL MssCol 565, Alexandre Brongniart to Parker Cleaveland, ALS, Paris, 15 June 1821

⁵ YUL MS 450, Box 18, folder 19, Silliman to Alexandre Brongniart, ALS, 16 October 1818

Brongniart's hand survives in Yale University Library⁶. Extensive extracts of the letter received by Silliman on December 1819 were however published in the third volume of the *American Journal of Science* (Al. Brongniart and Silliman, 1821). They give valuable information about the nature of the fossils and rocks forwarded by Silliman in October 1818. The specimens included serpentine of New-Haven, shales of Wilkes-Barre, Pennsylvania and Rhode-Island, containing impressions of fern, fossils from Lake Ontario and Cayuga County, and a slab of black shale with an impression of a fish from Westfield, one of the very first fossil fishes ever reported in the United States (Al. Brongniart and Silliman, 1821, p. 219–220). Brongniart responded to Silliman's generosity by sending copies of his works, a collection "of substances adapted to the manufacture of porcelain"⁷, as well as some minerals and rocks illustrating the mineralogical and geological survey of the vicinity of Paris made by him and Cuvier (Cuvier and Brongniart, 1808, 1811) (table 2, line no. 6). Brongniart was struck by the resemblance of the Westfield fish with those found in the Permian formations of Europe (we will see after that the former belongs to Redfieldiidae and the latter to Palaeoniscidae and Aeduellidae). As he wrote on 8 October 1819, "for the purpose of convincing you of these analogies, so remarkable on account of the great distance, and still, so complete, notwithstanding this distance", Brongniart also sent Silliman a fossil fish from the Upper Permian of Mansfeld, Germany, and a second one from the Lower Permian (Autunian) of Muse, near Autun, France. He concluded: "You perceive sir, how this first and singular specimen [Westfield fish] has excited my curiosity, and what a pleasure you will do me if you can procure others for me".

Silliman expressed his gratitude to Brongniart in a subsequent letter dated 28 April 1820 (Bork, 1999, p. 237)⁸. More importantly, he was so enthusiastic to gather fossils for Brongniart that he began to write to various friends who might help him in this task. He contacted Edward Hitchcock of Deerfield, Massachusetts, Ebenezer Granger (1781–1822) of Zanesville, Ohio, Jacob Cist (1782–1825) of Wilkes-Barre, Pennsylvania, George Thomas Bowen (1803–1828) of Providence, Rhode-Island, James Pierce of Catskill, New York, and Edmund Fanning Wickham (1796–1843) of Richmond, Virginia (Al. Brongniart, 1822). The former had made first contact with Silliman in the summer of 1817 by sending some specimens of Massachusetts minerals he wished to have identified (Herbert, 2012). Hitchcock had mentioned fossil fish at Sunderland in the second number of the *American Journal of Science* (Hitchcock, 1818, p. 110). At Silliman's request and expense, Hitchcock employed workmen to dig up for more fish. Few specimens were sent to New Haven in or before February 1821 as testified by Silliman's acknowledgement letter (table 2, line no. 7):

"I thank you much for remembering the fish. I have received another interesting letter from Brongniart just returned from a geological tour into Italy & he is very desirous of more of our remains & is much interested about them. I shall send him the fish you gave me & will mention you as the discoverer & I will thank you to let the men persevere in exploring & I will pay them. I should like while they are fishing to have them catch enough for a dinner".⁹

Brongniart's letter mentioned by Silliman was dated 3 November 1820. Its English translation was also published in the *American Journal of Science* (Al. Brongniart and Silliman, 1821, p. 223–226). In this letter, Brongniart expressed his desire to establish possible correlations between geological formations in Europe and North America by means of comparing rocks and fossils from both sides of the Atlantic.

⁶ YUL MS 450, Box 18, folder 19, Alexandre Brongniart, AN, 8 October 1819

⁷ YUL MS 450, box 34B, folder 59

⁸ YUL MS 450, Box 18, folder 19, Silliman to Alexandre Brongniart, ALS, New Haven, 28 April 1820

⁹ EOH Box 3, folder 37, Silliman to Hitchcock, ALS, New Haven, 14 February 1821

Organick Impressions Sent Mr Silli-
man April 1821.

No. 1. Pudding Stone or Gray White Slate from
the bottom of Gt. River —
No. 2. Slate with one species of fish
No. 3. Same rock — another species of fish
No. 4. Same rock Fish Impression — 2 fish lying among
each other
No. 5. Fish Impression same rock
No. 6. Do — Do
— 7. Organick Remains in same rock
— 8. Do — Do — Do
— 9. Specimen of Breckish slate 200 feet above the fish
— 10. Do — Brown slate 300 feet above the fish
— 11. Do — Do — Do — with
vegetable or animal which
— 12. vegetable remains in the same general
formation (Gulls in Gills)
— 13. Slate 300 feet above the fish containing
a clean shell?

Fig. 3. List of the “organick [sic] impressions” from Sunderland sent by Edward Hitchcock to Benjamin Silliman on 9 April 1821. Edward and Orra White Hitchcock Papers (Series 2, Edward Hitchcock: Correspondence, Sub-series B: Outgoing Correspondence, Box 5, Folder 12). Archives & Special Collections at Amherst College.

On 9 April 1821, Hitchcock wrote to Silliman that he would forward him the following day a box of “organic impressions”, mainly fossil fishes from Sunderland (table 2, line no. 8):

“I had almost despaired of prevailing upon any one by the open ground to engage in digging fish impressions. But at length I have just secured a large supply, perhaps 50 or 60 specimens, most of them however mutilated. And I have a chance of sending tomorrow morning to Hartford so must endeavour to put up a box. Although it is late at night & therefore I fear I shall make some blunder you will perceive the very distinct species of the fish & I shall put up specimens of some other organic beings I know not what & also of the rocks above and below the petrifications. On the other page you will find a list [see fig. 3]. You must not blame me for not stating the expence for the men employed have not yet presented their bill to me. I shall not send a great number of impressions at this time as I fear they will be injured & fear also that they will not reach you. I shall take the liberty to direct them to your friend Mr. Wadsworth of Hartford because I know of no method to forward them

from there. [. . .]. If possible, Sir, I hope you will get the names of the fish impressions & other remains & rocks from M. Brongniart [sic] – And in particular be so good as to request his opinion whether these rocks belong to the secondary or transition class. This is a question that still remains undecided in my mind”.¹⁰

This extract reveals that Sunderland fish and other rocks collected by Hitchcock were intended to be forwarded to Brongniart in the hope to have his opinion about them. The detailed list of the specimens was given by Hitchcock on a separate sheet (fig. 3) and was later published by Silliman in the *American Journal of Science* (Silliman and Hitchcock, 1821):

“Organick [sic] Impressions sent Mr. Silliman April 1821.

No. 1. Pudding Stone or Grey Wacke [grauwacke] Slate from the bottom of Ct. [Connecticut] River.

No. 2. Slate with one species of fish.

No. 3. Same rock, another species of fish.

No. 4. Same rock Fish Impression - 2 fish lying across each other.

No. 5. Fish Impression, same rock.

No. 6. Do [ditto], Do

– 7. Organick Remains in same rock.

– 8. Do, Do, Do

– 9. Specimen of reddish slate 200 feet above the fish.

– 10. Do Brown slate 300 feet above the fish.

– 11. Do, Do, Do, with vegetable or animal relic. [sic]

– 12. Vegetable remains in the same general formation (Falls in Gill)

– 13. Slate 300 feet above the fish containing a clam shell”¹¹

In response, Silliman acknowledged Hitchcock in a letter dated 21 April 1821, taking this opportunity to give advice on the safest way to send the fragile slabs of fish from Deerfield to New Haven:

“A pretty serious indisposition and many calls on what little health I have had left for six weeks passed must plead my excuse for omitting to answer your very kind favour respecting the fish. I am under very great obligations to you for your kindness and attention & must beg to be informed as soon as may be what is the expence. I will remit the money to you promptly or pay it here if you have occasion to pay any here. I think the fish &c should by all means come by water as they would unless very carefully packed be much injured by a land journey. I will thank you to give a written memorandum to the boatman or to save you the trouble of writing it, I will annex one which you will be so kind as to tear off & hand or commit to the boatman. As I know from experience that some of those people are very unreasonable in their demands, I should be obliged (if you can do it without too much trouble) by having the fare paid at first & inscribed as paid on the box & let me know the amount with the other expence. I wish very much to get the box soon as I shall forthwith make up one for Mr. Brongniart. I will not fail to ask him the questions that you desire”.¹²

In or before July 1821, the box of “*Ichthyolites*” was received by Silliman (table 2, line no. 8).

“The box of *Ichthyolites* I duly received and am very much obliged to you for your care & attention about them. I beg you will never think of apologizing for mentioning any expences you may incur on my account unless you would prevent my repeating any applications to you in future. [. . .]. The remaining *Ichthyolites* I should be glad to receive when convenient & should there at any future time be discovered any specimens where the fish is entire I will make the people who find them any reasonable compensation for them”.¹³

Silliman did not wait longer to receive more Sunderland fish from Hitchcock and on August 1821, he decided to send to Brongniart what he already had in his possession. He also forwarded fossil plants obtained from Ebenezer Granger in the coal formation

¹⁰ EOH Box 5, folder 12, Hitchcock to Silliman, ALS, Deerfield, 9 April 1821

¹¹ EOH Box 5, folder 12, Hitchcock to Silliman, ALS, Deerfield, 9 April 1821

¹² EOH Box 3, folder 37, Silliman to Hitchcock, ALS, New Haven, 21 April 1821

¹³ EOH Box 3, folder 37, Silliman to Hitchcock, ALS, New Haven, 27 July 1821

of Zanesville, Ohio. In the letter notifying Brongniart of the imminent shipment of the box, Silliman wrote:

“By the British brig Betsey, to sail from New York this day for Havre [Le Havre, France], I send you to the care of Mess^{rs} E. E. Aubré Havre, and of Mr. Barnet [Isaac Cox Barnet (1773–1833)] American consul at Paris, a box of animal and vegetable impressions, from several coal regions in N. America. I am particularly gratified in the opportunity of sending you some very distinct impressions from Zanesville on the Muskingum River, whose embouchure, you will perceive, is in the river Ohio. It is to be presumed that these impressions may be considered as representing with tolerable accuracy, the vast bituminous coal formations, which commencing West of the Allegheny mountains are found in many places, both East and West of the Mississippi and North and South of the Ohio. I am however taking measures to have other collections formed. You will perceive that, by various notices in the American Journal, I am inviting the cooperation of persons residing in remote regions of this country, and I have written letters also for the same purpose to various individuals. Some time must elapse before returns can be obtained from countries which are geographically almost as extensive as all Europe, but I shall not cease to prosecute the subject, and I hope either through my own hands, or those of other persons, to send you suites of specimens from various regions of North America. Those which I have sent you by the Betsey are quite the best, and as respects some species, they are the only ones in my possession.

You will do the American scientific public a service, by making such remarks upon them as you are willing should be published in this country where they will in turn excite a favourable influence & create a spirit to aid you in your great work; for your character, as a scientific man is held in high respect in the United States. [. . .].

As proof that your wishes are not disregarded in this country, I may mention that the specimens from Zanesville were obtained for your use, through the exertion of a very jealous friend of science, M^r Caleb Atwater [1778–1867] of Circleville Ohio, who induced his friend M^r Ebenezer Granger of Zanesville to obtain the specimens and to transmit them to me; that the exertions of M^r Edward Hitchcock as to the Sunderland fish were prompted in a similar way, finally, that M^r Zachariah Cist [Jacob Cist] of Wilkesbarre in Pennsylvania, has put up for you a collection of the impressions belonging to the Wilkesbarre anthracite formation. These he will forward to you via Philadelphia, to the care of Professor Robert Hare [1781–1858].”¹⁴

Silliman also apologized for having published extracts of Brongniart’s letters of 8 October 1819 and 3 November 1820 (Al. Brongniart and Silliman, 1821) arguing that it was the best way to make the American scientists know Brongniart’s views and wishes to receive specimens. As a matter of fact, Brongniart did not appreciate Silliman’s initiative and stated that private letters, such as the ones he addressed to his American colleague, may contain superficial results and assumptions not intended to be published. Brongniart diplomatically reminded the elementary rules governing scientific communications¹⁵. The incident had however no consequence on the very cordial relationship and fruitful collaboration between the two men. The box containing the Sunderland fishes and Zanesville fossil plants arrived in Paris in or before May 1822. The same month, Brongniart also received a box with fossil plants from the Carboniferous coal formation of Wilkes-Barre, Pennsylvania (table 2, line no. 11). It had been forwarded, at Silliman’s request, by Jacob Cist, a naturalist, artist, inventor and businessman, known to be one of the most important pioneers in the marketing of anthracite coal and a leading authority on its economic potential (Kulp, 1890, p. 1342–1353; Powell, 1978). In a letter dated 23 May 1822, Brongniart expressed great interest in “*the various specimens of American organized remains which he had received*”. On behalf of Brongniart, Silliman published his acknowledgment (Al. Brongniart, 1822) and concluded:

“Should the friends of Geology continue [. . .] to furnish similar specimens to Mr. Brongniart he will soon be in a condition to draw those general conclusions respecting the American formations by means of which they can be successfully compared with those of the Eastern Continent”.

¹⁴ YUL MS 540, Box 18, folder 19, Silliman to Alexandre Brongniart, ALS, New Haven, 7 August 1821

¹⁵ APS Mss.B.Si4, Alexandre Brongniart to Silliman, ALS, Paris, 30 September 1821

In return, Brongniart put up a collection of minerals and fossil shells for satisfying Silliman's desire of improving his knowledge in the field of what will be later called paleontology. As written by Silliman: "At present, I will mention, that labeled specimens of any fossil shells, even of those that are common & familiar, would be very acceptable, because I acknowledge myself, deficient in the knowledge of these extinct races of beings, and this is the case, much more generally, with American, than with European geologists"¹⁶. The box sent by Brongniart was long thought to be lost during transportation but finally arrived in New Haven more than one year later in September 1823 (table 2, line no. 12) (Bork, 1999, p. 239). In the meantime, Silliman continued in his efforts to obtain for Brongniart fossil specimens from other places in the United States. He was informed that Brongniart's son, Adolphe (1801–1876), wished to obtain fossil plants from the coal formations of North America¹⁷. Adolphe Brongniart is often considered as the founder of paleobotany. He was engaged at that time in writing an ambitious work "*Histoire des végétaux fossiles*" [History of fossil plants] that was however never completed (Ad. Brongniart, 1828–1838). Two boxes of fossils and plant remains, the one from Catskills, and the other one from the coal mines of Richmond, Virginia, were forwarded to Adolphe Brongniart and his father in June 1823 (table 2, line no. 13). Interestingly, Benjamin Silliman and Jacob Cist became direct correspondents of Adolphe Brongniart (Kulp, 1890, p. 1350)¹⁸. The latter's work entitled "*Sur la classification et la distribution des végétaux fossiles*" [On the classification and distribution of fossil plants] contains the first allusion to Granger's specimens from Zanesville received few months earlier (Ad. Brongniart, 1822, p. 229). It was reviewed in Silliman's *American Journal of Science* (Silliman, 1823; Percival, 1824). Most of the American specimens of fossil plants from Zanesville, Wilkes-Barre, and Richmond sent to Paris between 1821 and 1824 (table 2, lines no. 10, 11, 13, and 14) were described and figured in Adolphe Brongniart's "*Histoire des végétaux fossiles*" (Ad. Brongniart, 1828–1838; Lesquereux, 1877). Many new species introduced in these works were named in honor of Benjamin Silliman, Jacob Cist and Ebenezer Granger. Without considering their validity or proper generic attribution, these include *Sigillaria sillimanni*, *Pecopteris sillimanni*, *Sigillaria cistii*, *Pecopteris cistii*, *Calamites cistii*, *Neuropteris cistii* and *Neuropteris grangeri*. Adolphe Brongniart donated his entire collection of fossil plants to the Muséum d'Histoire naturelle, Paris (former name of the MNHN) (Rousseau and Lemonnier, 1837, p. 472). Many of the American specimens, including type material, from Rhode-Island (table 2, line no. 5), Zanesville (table 2, line no. 10), Wilkes-Barre (table 2, lines no. 11 and 14), and Richmond (table 2, line no. 13), that were sent by Silliman and Cist in the 1810s and 1820s, are still kept in this museum¹⁹. In the 1830s, Alexandre and Adolphe Brongniart also received other American fossils from the botanist and geologist Amos Eaton, and the physician, naturalist, and physical anthropologist Samuel George Morton (1799–1851). The specimens included fossil plants, trilobites, and fossils from the Cretaceous (Eaton, 1832, p. 33; 1840, p. 154)²⁰.

Silliman suggested that "possibly some additional" and "better specimens of fossil fish" from Sunderland could be forwarded to Alexandre Brongniart²¹ but this apparently

¹⁶ YUL MS 540, Box 18, folder 19, Silliman to Alexandre Brongniart, ALS, New Haven, 7 August 1821

¹⁷ APS Mss.B.Si4, Alexandre Brongniart to Silliman, ALS, Paris, 30 September 1821

¹⁸ BCM Ms1970/390-392, Silliman to Adolphe Brongniart, ALS, New Haven, 27 June 1823, 13 May 1824, 11 June 1824; NYL MssCol 565, Adolphe Brongniart to [Silliman], ALS, Paris, 10 January 1824; BCM Ms1969/122-124, Cist to Adolphe Brongniart, ALS, Wilkesbarre, 27 May 1823, 15 June 1824, 17 June 1824

¹⁹ Specimen numbers MNHN.F.106, 110, 130, 138, 140, 141, 194, 364, 370, 399, 416, 424, 437, 462, 568, 606, 633, 659, 727, 730, 759, 838, 895, 906, 998, 1028, 1079, 1105, 1147, 1171, 1203, 1206, 1217, 1220, 1221, 1238, 1256, 1289, 1372, 1380, 2032, 3378, 3421, 3434, 3463, 3513

²⁰ BCM Ms1965/247, 248, Eaton to Adolphe Brongniart, ALS, Troy, 24 September 1830 and 2 October 1833

²¹ YUL MS 540, Box 18, folder 19, Silliman to Alexandre Brongniart, ALS, New Haven, 15 January 1822

never happened as far as I know. Hitchcock eagerly awaited Brongniart's opinion on the geological position of the black shales found in what will be later named the Deerfield Basin, as well as more detailed description of the Sunderland fish (Hitchcock, 1823a, p. 76). Silliman had to confess to Hitchcock: "*I have not heard anything from Mr. Brongniart respecting the Sunderland fish but will inform you when I do*"²². I have not found any answer from Brongniart on this subject in available archives I have seen (APS, BCL, BCM, EOH, YUL). In his letter of 8 October 1819, Brongniart only briefly noticed that the Westfield fish forwarded by Silliman on 16 October 1818, was identical to "*Palaeothrissum freislebenense de Mr. Blainville*", referring to the palaeonisciform fish *Palaeoniscum freieslebeni* Blainville, 1818 from the Upper Permian of Germany (Al. Brongniart and Silliman, 1821; Al. Brongniart and others, 1822; Hitchcock, 1823a, p. 76; 1833, p. 208; 1835, p. 212). It must be said that, in the domain of geosciences, Alexandre Brongniart was mainly known as a specialist of mineralogy, geology, and invertebrate paleontology. At that time, he was occupied to prepare with his colleague Anselme-Gaëtan Desmarest (1784–1838) a work on fossil crustaceans and trilobites (Al. Brongniart and Desmarest, 1822), and the new edition of the geology of the vicinity of Paris (Cuvier and Al. Brongniart, 1822). The study of paleoichthyology, as it would later be called, was in its infancy in the 1820s (Dean, 1999, p. 141). The only available scientific work in this field was that of the French zoologist Henri Marie Ducrotay de Blainville (1777–1850) (Blainville, 1818). Georges Cuvier was internationally renowned as the most talented specialist of "*fossil quadrupeds*" which included mammals, birds, reptiles and amphibians. He also intended to study fossil fishes (Brignon, 2015b, 2016). Brongniart was clearly looking for Cuvier's assistance to identify fossil fish as he wrote to Silliman "*il [Cuvier] fera je l'espère les poissons [fossiles] du moins il me l'a promis*" [Cuvier will study, I hope, fossil fishes, at least he promised to do so]²³. Cuvier (1824, p. 309) had the opportunity to see fossil fish from Connecticut in Brongniart's collection as mentioned in the second edition of his "*Recherches sur les ossements fossiles*" [Researches on fossil bones] but he never published any description about them. After completion of his great book in 1824, Cuvier wanted to focus his research on fossil fishes (Brignon, 2016). For dealing with this matter, Cuvier had first to acquire a perfect knowledge of the osteology of living species. This was his primary motivation to undertake his "*Histoire naturelle des poissons*" [Natural history of fishes], a monumental work that he began to write with the collaboration of his former student Achille Valenciennes (1794–1865). Louis Agassiz had the same project of studying fossil fishes but in the early 1830s his was considerably more advanced than that of Cuvier. A few months before his death (13 May 1832), Cuvier met Agassiz in Paris and finally decided to renounce his project in favor of the young Swiss naturalist (Agassiz, 1885).

THE FIRST SEMIONOTID FISHES FROM THE NEWARK SUPERGROUP NAMED BY AGASSIZ

Agassiz's five-volume "*Recherches sur les Poissons Fossiles*", published over a period of more than ten years, between 1833 and 1844, is a landmark work for paleoichthyology (Gaudant, 1980; Brignon, 2014). Agassiz started to study fossil fishes in Munich but it became necessary that he should carry his work to Paris where he wanted to have access to the zoological and paleontological collections of the Muséum d'Histoire naturelle. On the 16th of December, 1831, Agassiz arrived in Paris with his hired artist Joseph Dinkel, employed in making illustrations for his books (Agassiz, 1885, p. 162). During his stay, he met Georges Cuvier, Alexander von Humboldt, and Alexandre Brongniart who helped him in his project. The latter had accumulated a nice geological collection with a wealth of fossil fish specimens which were placed at Agassiz's disposal. In a letter

²² EOH Box 3, folder 38, Silliman to Hitchcock, ALS, New Haven, 8 May 1822

²³ APS Mss.B.Si4, Alexandre Brongniart to Silliman, ALS, Paris, 30 September 1821

to his mother dated March 25, 1832, Agassiz wrote about Brongniart's collection of fossil fishes that it was one of the finest among those owned by individuals in Paris (Agassiz, 1885, p. 176; 1887, p. 131). The collection had been used by Henri Marie Ducrotay de Blainville for his classic study on fossil fishes published in 1818 (Blainville, 1818). In the first *livraison* (installment) of his "*Recherches sur les Poissons Fossiles*", Agassiz (1833, v. 1, p. 6) indicated slabs of fish from Sunderland in Brongniart's collection. A manuscript document kept in the archives of Louis Agassiz (AEN 123/4.1) giving the list of the fossil fishes (Chondrichthyes and Osteichthyes) in this collection, also mentioned a specimen of "*Palaeothyrsus* [sic]" from Westfield, Connecticut. As shown previously, all these Westfield and Sunderland specimens had been sent by Silliman in 1818 and 1821 (table 2, lines no. 5 and 10).

Although Hitchcock (1823a) published figures of Newark semionotids (fig. 2) ten years before, Louis Agassiz (1833) was the first to describe scientifically two of them under the name *Palaeoniscus fultus*. This species was later included in the genera *Ischypterus* by Egerton (*in* Lyell, 1847, p. 277) and *Semionotus* by Woodward (1895, p. 58). The two fishes described by Agassiz were part of the specimens collected by Edward Hitchcock at Whitmore's Ferry in or before April 1821 and were received by Brongniart from Silliman in 1822 (table 2, line no. 10). The plate depicting the two fishes was published in 1836 (Agassiz, 1836, v. 2, pl. 8). The corresponding original watercolor painted by Joseph Dinkel between 1832 and 1836 (fig. 4) is still kept in the Library of the Geological Society of London together with all the original drawings that serve to prepare the lithographed plates of Agassiz's *Recherches sur les Poissons Fossiles* as well as unpublished drawings (Brignon, 2015a, 2015c). Agassiz did not designate a type for "*Palaeoniscus fultus*" explicitly, but one of the two syntypes (fig. 4, specimen on the left; Agassiz, 1836, v. 2, pl. 8, fig. 4) with "*Imperfect trunk, wanting head*" was chosen as the "type" by Woodward (1895, p. 59) and is thus the lectotype of the species under authority of article 74.5 of the International Code of Zoological Nomenclature (ICZN, 1999). The second specimen wanting caudal fin and posterior part of the body (fig. 4, specimen on the right; Agassiz, 1836, v. 2, pl. 8, fig. 5) is the only paralectotype. It was also figured for the first time by Hitchcock (1823a, pl. 9, fig. 1; 1833, 1835, pl. 14, fig. 46) as shown in figure 2A. Contrary to the view of William Charles Redfield (1841, p. 25), the illustration of this specimen published in Agassiz's book was painted from nature by Dinkel and was not copied after the imperfect figure given by Hitchcock. In fact, Hitchcock (1841, p. 459) himself admitted many years later after the publication of the drawings shown in figure 2 that the artist was not careful enough to properly exhibit the form of the fins.

The English geologist William Buckland (1784–1856) proposed Agassiz come to Britain "*to see the fossil fish in the various provincial museums of England, as well as in London*" as he wrote on Christmas day 1833 (Agassiz, 1885, p. 232). Agassiz enthusiastically accepted Buckland's invitation and went to England in August 1834. In the collections of the Geological Society of London, he had the opportunity to study a Sunderland fish that had been offered by Roderick Impey Murchison (1792–1871). Louis Agassiz (1835, v. 2, p. 159–160; 1836, v. 2, pl. 14c, fig. 4) described and figured this fish under the name *Eurynotus tenuiceps*. The species was also later included in the genus *Semionotus* Agassiz, 1832 by Woodward (1895, p. 59–60) who also designated the Geological Society specimen as the "type". The two fishes figured by Hitchcock (1823a, pl. 9, fig. 2-3; 1833, 1835, pl. 14, fig. 45, 48), and shown in figures 2B and 2C, were also regarded by Agassiz as being part of the species. In consequence, the Geological Society specimen is to be considered the lectotype (not the holotype as stated in McCune, 1987, p. 72) and the two specimens figured by Hitchcock become therefore paralectotypes. In 1911, the Geological Society's mineral and fossil collections were transferred to the Geological Museum (originally the Museum of Practical Geology)



Fig. 4. Original watercolor (LDGSL/613/2/23/2) by Joseph Dinkel (1806–1891) depicting two specimens of *Semionotus fulvus* (Agassiz, 1833) in the collection of Alexandre Brongniart. The drawings on the left and on the right represent respectively the lectotype and the only paralectotype of the species. The watercolor was executed in Paris between 1832 and 1836 under the direction of Louis Agassiz to illustrate his “*Recherches sur les poissons fossiles*” published from 1833 till 1844. These two specimens were collected at Whitmore’s Ferry, north Sunderland, Massachusetts (Early Jurassic, Deerfield Basin, Newark Supergroup) by Edward Hitchcock in or before April 1821 and sent by Benjamin Silliman to Alexandre Brongniart on 7 August 1821. Reproduced by permission of the Geological Society of London.



Fig. 5. One of the first articulated fossil fishes (*Redfieldius* sp.) discovered in the United States (Brongniart collection, UPMC.PAL.2017.0.1.7, old number 12879). This specimen was collected in Westfield, near Middletown, Connecticut (East Berlin Formation, Hartford Basin, Early Jurassic). This discovery was first mentioned by Benjamin Silliman in 1816 in Parker Cleaveland's "*Elementary Treatise on Mineralogy and Geology*" (Cleaveland, 1816, p. 174, 363). The specimen was sent by Silliman to Alexandre Brongniart on 16 October 1818 (table 2, line no. 5). Scale bar, 5 cm. The bottom image is a closer view of the label affixed to the specimen.

that later merged with the British Museum (Natural History) (now the Natural History Museum). However, Agassiz's figured specimen (lectotype) of *Semionotus tenuiceps* cannot be found either in the Natural History Museum, London (Emma Bernard, personal communication) or in the paleontological collection of the British Geological Survey in Keyworth (Paul Shepherd, personal communication). Thirty years ago, McCune (1987) had reached the same conclusion, that the specimen must be considered lost. Furthermore, in view of the poor quality of the drawings given by Hitchcock, it appears very difficult to pinpoint the paralectotypes of *Semionotus tenuiceps* which could have potentially found their way in the Beneski Museum of Natural History that holds some fossils of the Hitchcock's collection. It should be noted that a neotype specimen (YPM VP.008162) was designated to serve as the standard of comparison for *S. tenuiceps* (McCune, 1987).

REDISCOVERY OF THE FIRST FOSSIL FISHES FOUND IN THE UNITED STATES

As far as I know, none of the first fossil fishes from the Newark Supergroup discovered in the 1810s and the 1820s have been identified in American museums. Most of these specimens were in the hands of Benjamin Silliman and Edward Hitchcock at some point. However, none of them were found among the remainders of Silliman and Hitchcock's fossil collections stored respectively in the Yale Peabody Museum of Natural History (Narendra, 1979) and the Beneski Museum of Natural History (formerly the Pratt Museum of Natural History). Many of the surviving fossils from Silliman's collection bear the initials "BS" handwritten on labels or specimens (Starquist, 1974). Notably, a nice collection of fossils and lithologic samples from England donated by his friend Gideon Mantell (1790–1852) is kept in the Peabody Museum. It includes dinosaur (*Iguanodon* sp., YPM VP.004188-89) and *Ptychodus* shark (YPM VP.003163, 79) teeth. The only fossil fish slabs still preserved in the Peabody Museum known to be acquired by Silliman are two specimens from the Eocene of Monte Bolca in Italy (YPM VP.002985-86) (Daniel L. Brinkman, personal communication). Interestingly, the Beneski Museum holds three *Semionotus* specimens (ACM 1182, 1234 and 5037) collected in Sunderland, Massachusetts, that are listed in the Museum catalog as being part of the "Hitchcock collection" (Kate Wellspring, personal communication). Unfortunately the catalog does not indicate what year the fossils were collected. Two of the slabs (ACM 1182 and 1234) are also marked with an additional catalog number "V 221". This number matches with a catalog listing the contents of the Massachusetts "Agricultural Museum" (Hitchcock, 1859, p. xxiii). The catalog was published in an appendix of the 1859 "*Sixth Annual Report of the Secretary of the Massachusetts Board of Agriculture*". Catalog number 221 corresponds to "*Ichthyolites (Eurynotus-Agas [Agassiz]) Sunderland*". The report also states that the objects in the catalog were collected between the years 1830 and 1840 (Hitchcock, 1859, p. iii). Many other Early Jurassic fish fossils from Sunderland are present in the Beneski Museum but collection records do not indicate that any of them (other than ACM 1182, 1234 and 5037) are associated with Edward Hitchcock or what year they were collected.

As most of the first fossil fishes discovered in the United States were sent by Benjamin Silliman to Alexandre Brongniart (table 2), they can be tracked to France. After Alexandre Brongniart's death, Adolphe Brongniart donated his father's paleontological collection to the laboratory of Geology at the Sorbonne's Faculty of Sciences, in Paris (Barrande, 1873, p. 328; Nénot, 1895, p. 59; Lacroix, 1919, p. 17). In 1972, Sorbonne's collections were moved to the University Paris VI (Pierre and Marie Curie University) located in the Jussieu campus, Paris. The former collections of the Sorbonne's laboratory of Geology therefore constitute the core of the Pierre and Marie Curie University Paleontological Collection (UPMC). It is worth noting, however, that several specimens, mostly fossil vertebrates, from the Sorbonne's laboratory of Geology were also donated to the Muséum national d'Histoire naturelle, Paris (MNHN). This

explains why fossils from Brongniart's collection can be found nowadays in both institutions, UPMC and MNHN. Specimens from this collection are quite easily recognizable by the two labels affixed to them in most cases. The first one written in Alexandre Brongniart's hand indicates the name and the origin of the specimen. The second, smaller one, is encircled by a decorative blue border and carries a handwritten collection number (Charbonnier and others, 2012, fig. 2A; Brignon, 2014, fig. 4). Searches in the UPMC and MNHN collections have enabled me to rediscover the fossil fishes from Connecticut and Massachusetts sent by Benjamin Silliman to Alexandre Brongniart (table 2, lines no. 5 and 10).

The first specimen (fig. 5) is of outstanding historical importance as it is one of the specimens reported in 1816 in Parker Cleaveland's *Elementary treatise on mineralogy and geology* (Cleaveland, 1816, p. 174, 363; Al. Brongniart and Silliman, 1821, p. 221). It is therefore, as far as I know, the very first articulated fossil fish found in the United States still preserved today. This specimen was collected "at the depth of about 40 feet, while exploring for coal" in Westfield, near Middletown, Connecticut and was found in the Early Jurassic lacustrine Westfield Bed of the East Berlin Formation within the Hartford Basin, Newark Supergroup. It was brought to Benjamin Silliman in New-Haven and then was sent to Alexandre Brongniart in October 1818 (table 2, line no. 5). The label affixed to the slab of shale is written in French by Brongniart. It reads as follows: "*Phyllade pailletée (avec impression de Palaeothrissum) d'une formation bitumineuse de Westfield. Sil [Silliman].18 [1818].7. près Middletown. Connecticut*" [Phyllade pailletée (with impression of *Palaeothrissum*) from the bituminous formation of Westfield. Silliman. 1818.7. near Middletown. Connecticut]. As usual for material from the Brongniart's collection, the label indicates the abbreviated name of the donor (here "Sil" for Silliman), and the two last number of the year in which the specimen was received (here "18" for 1818). The additional number "7" indicates the specimen number in the box received from Silliman and was certainly referring to a manuscript catalog, which is now lost.

The specimen is incomplete, wanting head, anterior part of the body and posterior part of the caudal fin. The dorsal and anal fins are still preserved. The fin rays have very short basal leptotrichia. The position of the dorsal fin, slightly posterior of the anal fin, and the small and delicate fulcra on all the fins are typical characters of the genus *Redfieldius* Hay, 1899 (Schaeffer and McDonald, 1978), one of the four genera of fishes recognized within the Hartford Basin (Leonard, ms, 2013). It is interesting to note that a *Redfieldius* specimen was therefore discovered in or before 1816 though the genus (first as *Catopterus*) was not recognized until 1837, the lectotype of the type species of which is from the Portland Formation of Middlefield, Connecticut (Redfield, 1837, pl. 1). As Brongniart wrote in his letter of 8 October 1819 (Al. Brongniart and Silliman, 1821), the fish shown in figure 5 was thought by him to be identical to "*Palaeothrissum freislebenense de Mr. Blainville*" referring to *Palaeoniscum freieslebeni* Blainville, 1818 (Actinopterygii, Palaeonisciformes, Palaeoniscidae) from the Upper Permian of Germany (Blainville, 1818, p. 320). He also noted that it was very similar with some other palaeonisciforms, now identified as belonging to the Aeduellidae family, that had been discovered in 1811 in the Lower Permian (Autunian) deposits of Muse, near Autun, France (Brignon, 2014). Together with the Westfield fish presented here, Silliman also sent Brongniart a slab with fossil plants from the Pennsylvanian of Rhode Island in October 1818. This specimen is also still housed in the Muséum national d'Histoire naturelle, Paris (MNHN.F.730). It contains leaves registered under the name *Pecopteris cistii* Ad. Brongniart, 1834.

Eight slabs with semionotid fishes from Whitmore's Ferry, north Sunderland, were also rediscovered in UPMC and MNHN (figs. 6, 7, 8, and 9). They were all collected by Edward Hitchcock and sent to Brongniart in August 1821 by Silliman (table 2, line no.

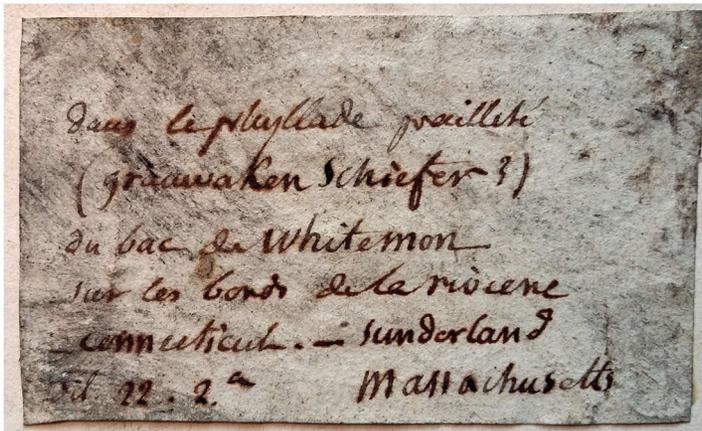


Fig. 6. Lectotype (A) of *Semionotus fultus* (Agassiz, 1833) with corresponding label (B) affixed at the back of the specimen. Part (C, D) and counterpart (E, F) of paralectotype of the same species with corresponding labels. All these specimens were collected by Edward Hitchcock in or before April 1821 at Whitmore's Ferry, north Sunderland, Massachusetts (Early Jurassic, Deerfield Basin, Newark Supergroup) (Brongniart collection; A, UPMC.PAL.2017.0.1.1; C, MNHN.F.SAD6; E, UPMC.PAL.2017.0.1.2). They were sent by Benjamin Silliman to Alexandre Brongniart on 7 August 1821 and were received in or before May 1822 (table 2, line no. 10). The labels are written in French by Brongniart. It reads as follows: "Bords de la riv. [rivière] Connecticut Sil [Silliman].22 [1822].2. Sunderland. Massachusetts" [Banks of the Connecticut River Silliman. 1822 Sunderland. Massachusetts]. C and D, photographs by Philippe Loubry (MNHN/CNRS, Paris). Scale bar, 5 cm.

10). The famous Sunderland fish bed from where all these specimens were extracted is composed of gray, thin bedded siltstones. It is probably a lateral continuation of "lake bed 3" within the Early Jurassic Turners Falls Formation exposed at Turners Falls (Olsen and other, 1992). The specimens bear a small label encircled by a decorative blue border, typical of those in Brongniart's collection. The first seven have additional contemporary labels in Brongniart's hand with the mention "Sil.22" referring to Silliman, and 1822, the year in which they arrived in Paris (fig. 6–8, 9A and 9C). The label affixed to one of these specimens bears more detailed indications (fig. 7B). It reads as follows: "dans le phillade pailletée (grauwaken Schiefer ?) du bac de Whitemon [sic] sur les bords de la rivière Connecticut. Sunderland. Massachusetts. Sil [Silliman].22 [1822]. 2" [in the Phillade pailletée (graywacke slate ?) at Whitmore's Ferry on the banks of the



A



B

Fig. 7. A, *Semionotus tenuiceps* (Agassiz, 1835) collected by Edward Hitchcock in or before April 1821 at Whitmore's Ferry, north Sunderland, Massachusetts, Early Jurassic, Deerfield Basin, Newark Supergroup (Brongniart collection, UPMC.PAL.2017.0.1.3, old number 12877). This specimen was sent to Alexandre Brongniart on 7 August 1821 by Benjamin Silliman (table 2, line no. 10). B, label affixed at the back of the specimen. It is written in French by Brongniart. Scale bar, 5 cm.

Connecticut River. Sunderland. Massachusetts. Silliman. 1822]. The eighth specimen bears an ink inscription, probably in Silliman's hand, written directly on the slab indicating "*Sunderland Mass. E. Hitchcock*" (fig. 9B). Only the trunk with scales, and fragments of dorsal and anal fins are preserved in this specimen making identification at the species level impossible.



Fig. 8. A, B, *Semionotus tenuiceps* (Agassiz, 1835) collected by Edward Hitchcock in or before April 1821 at Whitmore's Ferry, north Sunderland, Massachusetts (Early Jurassic, Deerfield Basin, Newark Supergroup) (Brongniart collection; A, UPMC.PAL.2017.0.1.4, old number 12872; B, MNHN.F.SAD5). These specimens were sent by Benjamin Silliman to Alexandre Brongniart on 7 August 1821 (table 2, line no. 10). C, label of specimen (B) written in French by Brongniart. It reads as follows: "Phillade pailletée avec ichthyolite de Sunderland, Massachusetts. E. de Hitchcock [sic]. Sil [Silliman].22 [1822]". B and C, photographs by Philippe Loubry (MNHN/CNRS, Paris). Scale bar, 5 cm.



Fig. 9. A, *Semionotus tenuiceps* (Agassiz, 1835) and B, *Semionotus* sp. collected by Edward Hirschcock in or before April 1821 at Whitmore's Ferry, north Sunderland, Massachusetts, Early Jurassic, Deerfield Basin, Newark Supergroup (Brongniart collection; A, UPMC.PAL.2017.0.1.5; B, UPMC.PAL.2017.0.1.6, old number 12878). These specimens were sent by Benjamin Silliman to Alexandre Brongniart on 7 August 1821 (table 2, line no. 10). C, label of specimen (A) written in French by Brongniart. Scale bar, 5 cm.

The type material of *Semionotus fultus* (Agassiz, 1833) figured and described by Agassiz has been identified among these slabs (fig. 6). The type (lectotype) designated by Woodward (1895) is incomplete, wanting head, anterior part of the body, and dorsal fin (fig. 6A). The only paralectotype is preserved with part (fig. 6C) and counterpart (fig. 6E). It is also incomplete, wanting posterior part of the body and caudal fin. The body shape of the type material of *S. fultus* is fusiform and relatively more slender than of *Semionotus tenuiceps*, known as the most common species in Sunderland. Hitchcock (1823a, p. 77–78; 1833, p. 236–237) noticed that 98 percent of the Sunderland fish belonged to the latter. *S. fultus* was so rare in the Sunderland locality that he had been unable to procure a single specimen for the Massachusetts State collection (Hitchcock, 1841, p. 459). Later, several fishes from Boonton, New Jersey, were referred to “*Palaeoniscus fultus*” or “*Ischypterus fultus*” [= *Semionotus fultus*] by Redfield (1841) and Newberry (1888) but were more recently identified as belonging to the *Semionotus elegans* group (Olsen and others, 1982; McCune, 1987, p. 3). Detailed anatomical analysis of the rediscovered Sunderland type material of *Semionotus fultus* would be required to ascertain the status of this species with respect to the currently accepted semionotid species of the Newark Supergroup, and possible taxonomic and nomenclatural implications. This study is however beyond the scope of this paper that aims to focus on the historical background of these early finds. Four slabs contain fish belonging to the species *Semionotus tenuiceps* (Agassiz, 1835) (figs. 7–8, 9A). The specimens are relatively deep bodied, with a pronounced dorsal hump and a deep belly. The scales of the anterior dorsal ridge are particularly robust and elaborate, a typical feature of this species (McCune, 1987). One slab contains two incomplete fish lying across each other (fig. 9A). Interestingly, its label in Brongniart’s hand bears number 4 matching certainly with that of Hitchcock’s list of organic remains from Sunderland forwarded to Silliman on 9 April 1821 (fig. 3) (Silliman and Hitchcock, 1821, p. 366).

CONCLUSION

The first articulated fossil fishes collected in the United States have been rediscovered in France on the occasion of the bicentennial of their discovery. They are of major significance for the history of American paleontology. Together with samples of rocks, minerals and fossil plants, they were sent to Alexandre Brongniart by Benjamin Silliman who had established an efficient network of local collectors including, among others, Edward Hitchcock. The French scientist was recognized by his American colleagues as a leading authority in geology and the science of “*fossil organized bodies*”, or “*paleontologie*” as it was coined by Henri Marie Ducrotay de Blainville in 1822 (Blainville, 1822, p. liv). By forwarding samples of rocks and fossils to Brongniart, Silliman and Hitchcock hoped to obtain in return information related to the stratigraphic position of the formations in which these specimens were found. Silliman had just launched his *American Journal of Science* and expected furthermore to publish texts or notes by a man having such a scientific reputation.

This cooperation, as for Brongniart, was a tremendous opportunity to enrich his paleontological collection with American fossil specimens but even more importantly to have a better knowledge of the geological formations encountered in North America and their possible correlations with those of Europe. Brongniart’s son, Adolphe, and Louis Agassiz directly benefited from this fossil material for their respective epoch-making works on paleobotany and paleoichthyology. The bidirectionality of the exchange ensured Silliman, on the other hand, to obtain from Brongniart fossils and rocks illustrating the geology of the vicinity of Paris, fossil shells, and substances adapted for the manufacture of porcelain. All of those were of great usefulness as educational material for Silliman’s lectures at Yale College and for the improvement of his own knowledge. After two centuries, such collections are somehow inevitably dispersed.

In this context, the set of American fossil fish rediscovered in French paleontological collections is a significant surviving testimony of early transatlantic scientific exchange in the geosciences at the beginning of the nineteenth century.

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