Proceedings of the Geologists' Association xxx (2018) xxx–xxx

Contents lists available at ScienceDirect

Proceedings of the Geologists' Association

journal homepage: www.elsevier.com/locate/pgeola

Mary Anning, Alfred Nicholson Leeds and Steve Etches. Comparing the three most important UK 'amateur' fossil collectors and their collections

Leslie F. Noè[a,*], Marcela Gómez-Pérez[a,1], Robert Nicholls[b]

[a] Departamento de Geociencias, Universidad de los Andes, Cra 1 No 18A-10, AA 4976, Bogotá D.C., Colombia
[b] 35, Hopps Road, Kingswood, Bristol BS15 9QQ, United Kingdom

ARTICLE INFO

Article history:
Received 24 June 2018
Received in revised form 31 August 2018
Accepted 3 September 2018
Available online xxx

Keywords:
Mary Anning
Alfred Nicholson Leeds
Steve Etches
Fossil collectors
Historical collections
Jurassic Lagerstätten

ABSTRACT

Mary Anning, Alfred Nicholson Leeds and Steve Etches form part of a long line of individuals who furnished a substantial addition to our understanding of marine and terrestrial ecosystems through collecting significant numbers of superb fossils. For all three collectors, fossils became a factor that dominated their lives, and their fossil collecting led to the discovery of numerous taxa new to science. Extensive collecting was made possible by the fortunate circumstances of living 'in the right place at the right time', close to fine-grained UK Jurassic deposits (Lagerstätten) with well-preserved large Jurassic marine reptiles. All three were highly-motivated and developed a considerable skill sets for discovering, collecting, preparing, conserving and displaying fossils. They developed personal and professional interactions with family and friends, and university and museum professionals, although their collecting resulted in variable recognition of their work. Each collector can be considered a complex mix of amateur and professional: Mary Anning, a professional fossil collector and amateur palaeontologist; Alfred Leeds transitioned from amateur to professional fossil collector, but remained an amateur palaeontologist; and Steve Etches has remained an amateur fossil collector and palaeontologist. However, all three exhibited an entirely professional outlook to collecting, and should be considered professionals of the highest degree. The impact of Mary Anning, Alfred Nicholson Leeds and Steve Etches has been critical for the development of Palaeontology as a science, and without whom palaeontology, with all its associated benefits to a wide scientific and non-scientific audience, would not be as rich as we currently know it.

1. Introduction

Non-professional, 'amateur', or private collectors of fossils and their collections are of great importance to palaeontology, as in many disciplines of scientific study (Leigh Star and Griesemer, 1989). However, the terminology available for these private individuals is problematic. 'Non-professional' implies both non-specialist (i.e. not specifically trained in a discipline, or lacking higher education qualifications) as well as something not undertaken to the highest standards. 'Amateur' can have four connotations: an enthusiast, or one that undertakes a task for love; one that is unpaid or that does not undertake a task for financial gain; one who is unqualified or without formal academic qualifications; and those that are sub-standard at a task they undertake (Torrens, 2006). 'Private' suggests something done without the knowledge of others, possibly hidden, as well as not being part of a public institution.

Collecting, gathering, amassing, accumulating and hoarding all appear to be part of the basic human condition (Belk, 1994). Humans have been collecting objects of personal interest for as long as recorded history, and probably longer, based on the archaeological record (e.g. McNamara, 2012). Other animals collect food and hoard it for lean times, as well as, apparently, for non-utilitarian reasons (Anderson et al., 2005). However, human collecting is often entirely freed from the utilitarian necessities for living, and allows private individuals, groups and societies to accumulate large bodies of objects and knowledge, for instance in personal, family, local, national and international museums (Pearce, 1994; Simmons, 2016). This may be one of the characteristics that make humans unique. Indeed, collecting of knowledge in a form that can be passed onto later generations, without the need for direct contact (in the form of written records, Coulmas, 1989), is

* Corresponding author.
E-mail addresses: l.noe@uniandes.edu.co (L.F. Noè), marcela.gomez@cantab.net (M. Gómez-Pérez), bob.nicholls@palaeocreations.com (R. Nicholls).
[1] Current address: Museo Geológico José Royo y Gómez, Servicio Geológico Colombiano, Diagonal 53 No. 34-53, Bogotá D.C., Colombia.

https://doi.org/10.1016/j.pgeola.2018.09.001
0016-7878/

unique to humans on our planet, so far as is known. Fossils have been found, together with other natural science and worked objects, as grave goods in archaeological sites (e.g. Wyse Jackson and Connolly, 2002). Hence, fossils have inspired humans for longer than our collective appreciation of their importance for understanding the history of life on Earth (Ramundo and Damborenea, 2011). This is probably due to the relative rarity of complete and well-preserved fossils, their beauty and inherently complex forms.

In this contribution, dedicated to the life and work of Steve Etches, we explore three key 'amateur' figures in UK (and global) vertebrate palaeontology: Mary Anning junior (1799–1847) of Lyme Regis, Dorset; Alfred Nicholson Leeds (1847–1917) of Peterborough, Cambridgeshire; and Steve Etches (b. 1949) of Kimmeridge Bay, Dorset. These three collectors have been selected due to their temporal spread (born in the 18th, 19th and 20th centuries), their long time spent collecting fossils (a minimum of 37 years each), the scientific importance of their collections, their individual scientific literacy and their considerable interactions with the scientific community. Other palaeontological collectors such as Dr John Woodward (1665–1728), Hugh Miller (1802–1856), Thomas Hawkins (1810–1889) and Gideon Mantell (1790–1852), could have been included.

2. The collectors and their collections

Here we present a summary of each collector, with notes on their personality and a biographical sketch. This is followed by an overview of their collections, and includes the geographical and geological setting, the types of fossils collected, the number and quality of specimens in their collections, examples of key specimens, and the location(s) of the collections today, where known.

2.1. Mary Anning

Mary Anning (1799–1847) (Fig. 1) is perhaps the single most famous historical fossil collector in the world, about whom more has been written than almost any palaeontological figure (Oldroyd, 2013; Taylor and Torrens, 2014). Within her lifetime, Mary Anning became well-known as a collector and seller of fossils, both to prominent scientists and wealthy collectors (e.g. Torrens, 1995). Undoubtedly numerous unrecorded collectors of curiosities also purchased fossils from the Annings.

Mary Anning was born in Lyme Regis on 21st May 1799 daughter of Richard Anning (c.1766-1810), a cabinet maker and part-time fossil collector and seller, and his wife Mary ('Molly') Anning (née Moore, 1764–1842) who married 8th August 1793 in Blandford Forum. Mary was the only surviving daughter of approximately 10 children begat by the couple; an older brother, Joseph (1796–1849) was the only other sibling to survive into adulthood. Mary was named after her mother, and a recently deceased first born child of the family, who died (27/12/1798) as the result of burns some five months prior to Mary's birth. Mary's background was therefore typical of the rural poor of the early 18th century, with its hardships and high infant mortality rate (Torrens, 1995).

Mary's early life was marked by an event that entered into local folk law, when, on 19th August 1800, as a baby of 15 months, she survived a lightning strike which killed three women, including the neighbour Elizabeth Haskings who was holding the infant Mary at the time. Mary was turned black but uninjured, and revived in a

Fig. 1. A painting of Mary Anning working along the Dorset coast, with the outcrop of Golden Cap in the background, collecting fossils and accompanied by her dog Tray, later killed in front of her by a cliff fall in 1833. This painting is by B.J.M. Donne (1850) copied from an c.1842 original believed to have been painted by William Grey, owned by Joseph Anning, and presented to the NHMUK by Annette Anning in 1935. Image courtesy of and copyright The Geological Society of London.

Please cite this article in press as: L.F. Noè, et al., Mary Anning, Alfred Nicholson Leeds and Steve Etches. Comparing the three most important UK 'amateur' fossil collectors and their collections, Proc. Geol. Assoc. (2018), https://doi.org/10.1016/j.pgeola.2018.09.001

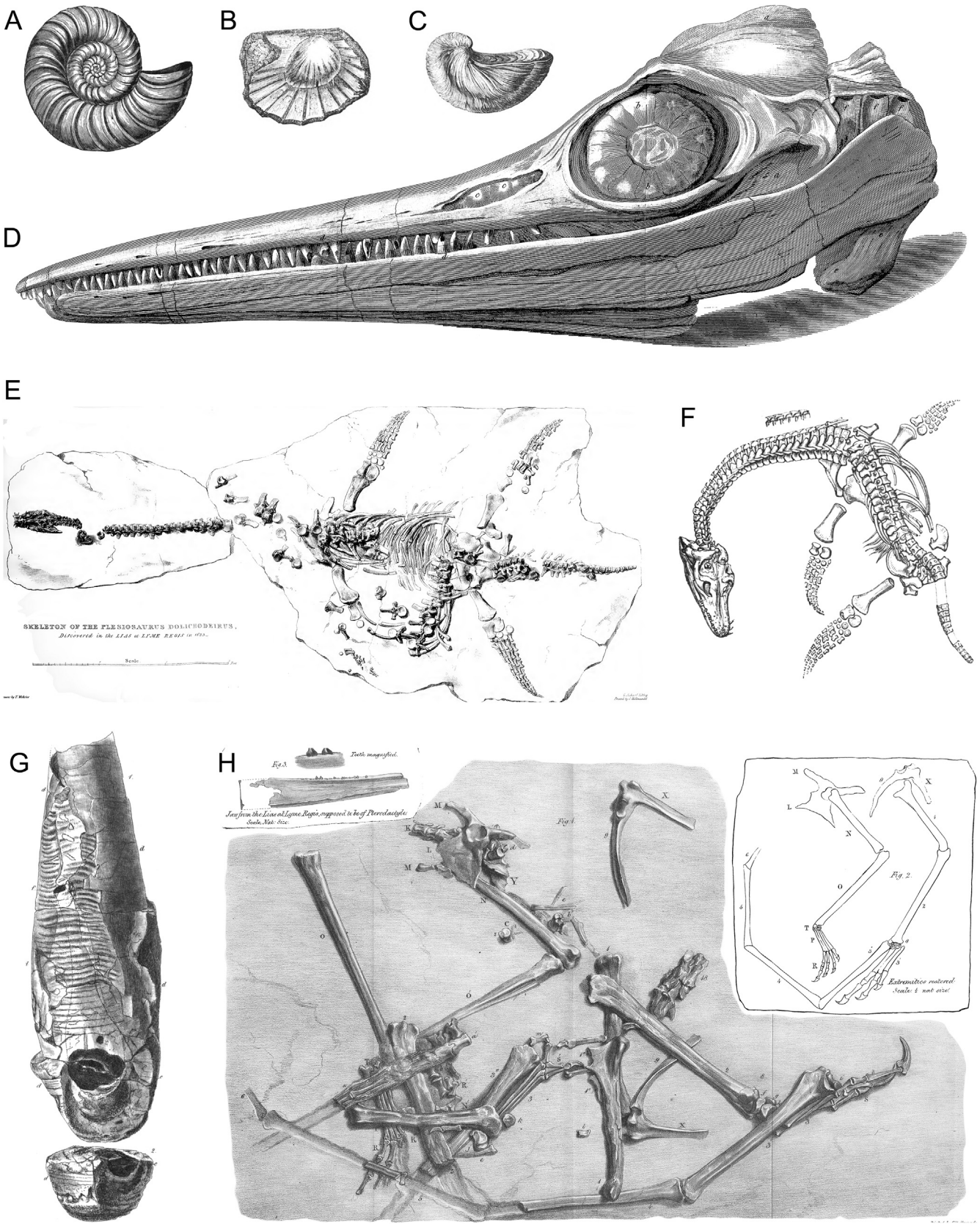

Fig. 2. Examples of fossils collected by Mary Anning and her family. A, B, C, Invertebrate fossils common in and around Lyme Regis, of the kind which may have been frequent sales to visitors to the town: A, *Ammonites communis*, B, *Avicula inæquivalvis* and C, *Gryphæa incurva* (using the names common at the time); D, the head of *Temnodontosaurus platydon*, discovered by Joseph Anning in 1811 and sold to Henry Hoste Henley, illustration made in Bullocks Museum, Piccadilly, London (now *Temnodontosaurus platyodon*, NHMUK R1158); E, holotype and first complete specimen of *Plesiosaurus dolichodeirus* (now NHMUK 22,656); F, *Plesiosaurus microcephalus* (now NHMUK 1336); G, 'belemnosepia' discovered by Anning in 1828, which includes part of the ink sac; H, *Dimorphodon macronyx*, the first British pterosaur discovered by Mary Anning in December 1828 (now NHMUK R1034). Sources: A, B, C, Zornlin (1852) pp 191, 193; D, Home (1814) plate XVII; E, Conybeare (1824) plate XLVIII; F, Buckland (1837) plate 19, 1; G, Buckland (1837) plate 44″, 1; H, Buckland (1829) plate 27.

Please cite this article in press as: L.F. Noè, et al., Mary Anning, Alfred Nicholson Leeds and Steve Etches. Comparing the three most important UK 'amateur' fossil collectors and their collections, Proc. Geol. Assoc. (2018), https://doi.org/10.1016/j.pgeola.2018.09.001

bath of warm water (Grant, 1827; Roberts, 1834). It is often reported that prior to this event Mary was a sickly baby, but subsequently grew up to be a strong and lively child (Roberts, c1830). However, whether this often repeated story about her health is true, or if the two events were causally related, cannot be stated with certainty. It is usually assumed Mary had a relatively limited education, although it is known she attended a Congregationalist Sunday school on Coombe Street, for which education of the poor was a priority, and where she learned to read and write. However, from her surviving written words (e.g. Grant, 1827; Anning, 1839), it is clear Mary was highly articulate and more than capable of expressing her thoughts and opinions in writing. Mary also read as widely as her financial situation allowed, as is evidenced by a subscription to Roberts's *History and Antiquities of the Borough of Lyme Regis and Charmouth* (Roberts, 1834).

Richard Anning began to collect and sell fossils to augment his income as a cabinetmaker, having accompanied Mr John Crookshanks on fossil hunting expeditions prior to 1802 (Roberts, 1834). Mary and her older brother Joseph later accompanied their father on fossil hunting expeditions despite Molly's apparent disapproval of these collecting activities (Roberts, 1834). As a Dissenter, Richard Anning undertook fossil hunting trips during Church of England religious holidays, thereby supplementing his income from cabinetmaking by selling fossils to the increasing number of tourists visiting Lyme Regis at the time (Anonymous, 1813). Mary's father died in November 1810 at the age of 44 from the results of tuberculosis ('consumption') complicated by the results of a fall from a cliff at night between Lyme and Charmouth (Roberts, 1834); at the time her father died, Mary was just 11 years old.

For much of the early part of her life, Mary Anning and her family struggled financially. The death of Richard left the remaining members of the Anning family with debts of 120 GBP (Grant, 1827), a considerable sum at the time, which required the family to apply for poor relief from the parish. However, following Richard's death, Molly continued to run the fossil business, most likely the family's only source of income. Joseph and Mary (and possibly Molly, although this is less clear) continued to collect fossils for sale, however, fossil hunting was a fickle business. Although low-value specimens such as ammonites and belemnites were common, there were often long gaps between the discovery of higher-value, scientifically significant fossils. So for much of Mary's early life, the Anning family lived in a house on the bridge at Lyme in the poorest lower part of the town (Anonymous, 1813). Proximity to the sea gave easy access to the rich fossil hunting grounds of the coast, but also meant their house was periodically flooded during winter storms.

Ultimately Mary and her family were able to purchase a house and shop in Broad Street, higher up in the town and further away from the sea (Grant, 1827). Mary and the Anning family made their names in scientific circles through finding new and spectacular fossil vertebrates, and increasingly during her lifetime, and later after her death, Mary became a local celebrity and draw for visitors to Lyme Regis (e.g. Carus, 1846; Grant, 1827): Mary herself had become a curiosity (Torrens, 1995). Mary continued collecting and selling fossils throughout her life, whereas Joseph's role in the fossil business diminished as he undertook an apprenticeship, and probably ended around 1825 when he became a full-time cabinetmaker. Following Richard's death, Molly was initially in charge of the fossil business, but handed the running over to Mary in about 1825: Molly died in 1842 (Torrens, 1995). However, by this time Mary was probably also ill with an aggressive and painful form of breast cancer, which considerably reduced here ability to obtain specimens in the later years of her life. Mary died on 9th March 1847 at the age of 48, leaving no direct descendants. She was buried in the churchyard of the Church of England St. Michael the Archangel in Lyme Regis on 15th March 1847. In 1850, as a result of the work of Henry de la Beche and other members of the Geological Society of London, a stained glass window was erected in memory of Mary Anning at the Nave end of St. Michael's church showing six acts of mercy (McGowan, 2001; Pierce, 2006).

Mary Anning is reported to have been a curious, lively and intelligent woman, who never married. She came from a relatively poor, rural, working-class background, and had a restricted education. However, she was clearly both highly articulate (Tickell, 1999), scientifically minded, and an avid reader. Mary wrote on 29th November 1824, in a letter to a child friend Miss Francis Bell, that 'the world has used me so unkindly, I fear it has made me suspicious of all mankind' (Grant, 1827, p. 132), although it is not clear if this was in relation to fossil hunting or her personal life. Mary was also modest and profoundly religious; she actively supported the church, and was extremely generous to the poor of the local Lyme Regis community. Although brought up as a Congregationalist (also Dissenter or Independent), Mary apparently converted to Anglicanism towards the end of her life.

2.1.1. The Anning 'collection'

Mary Anning and her family searched for saleable fossils along the Lower Jurassic (Hettangian to Sinemurian, approximately 201-190 Ma, Cohen et al., 2013; updated 2018-08) Blue Lias Formation limestones and shales of the Dorset coast, Southern England. The localities were the rapidly eroding seashore cliff exposures along the English Channel, between Lyme Regis and Charmouth (Anonymous, 1813). Fossils were most commonly exposed as a result of winter storms (Torrens, 1998), and Mary Anning collected from at least 1810 until close to her death in 1847. Hence, the Anning specimens at no time formed a single collection, as specimens were sold as they were discovered, and as buyers became available (Taylor and Torrens, 1986). In this respect, the Anning 'collection' was fluid and ever changing, and therefore different to those of Alfred Leeds and Steve Etches, whose collections were or are more coherent entities.

Mary Anning predominantly collected marine invertebrates and vertebrates, but also flying vertebrates and trace fossils, especially coprolites. Her stock-in-trade probably consisted of ammonites, belemnites and other invertebrates, whereas her scientific reputation was largely built on the spectacular marine vertebrates, such as ichthyosaurs and plesiosaurs, which were much more occasional finds (Fig. 2). Mary's most celebrated finds include the discovery of the postcranial skeleton of *Temnodontosaurus* in 1812 (the skull had been discovered by her brother Joseph in 1811); a beautiful 1821 *Ichthyosaurus communis*, which was eventually sold to the Bristol Institution in 1823; the holotype of *Plesiosaurus* in 1823 (Conybeare, 1824); the first British pterosaur in 1828 (Buckland, 1829a); the holocephalan *Squaloraja* in 1829 (Riley, 1837; Torrens, 1998); together with numerous other important fossil fish (e.g. Anonymous, 1829; Woodward, 1908), and the 1830 discovery of a young *Plesiosaurus macrocephalus* (Owen, 1840). Mary also sold numerous other vertebrates (e.g. Egerton, 1837; Taquet, 2003) and invertebrates, including belemnites in 1828 with fossilized ink sacs. She was instrumental in recognising 'bezoar stones' as coprolites (Buckland, 1829c), and recovered and sold numerous invertebrates including spectacular crinoids and ophiuroids (e.g. Fitton, 1836; Broderip, 1837; Torrens, 1995).

As a result of the continual sales of specimens, the totality of the 'collection' by Mary Anning and her family remains unknown, but was undoubtedly many thousands, especially including the sales of lower value specimens to tourists. Indeed, even the number of Anning specimens in public institutions is unknown, as the fossils are widely scattered across museums the UK, mainland Europe and the USA (Torrens, 1995). In addition, due to the nature of the sales and the lack of record keeping at the time, many specimens can no

Please cite this article in press as: L.F. Noè, et al., Mary Anning, Alfred Nicholson Leeds and Steve Etches. Comparing the three most important UK 'amateur' fossil collectors and their collections, Proc. Geol. Assoc. (2018), https://doi.org/10.1016/j.pgeola.2018.09.001

longer be attributed to the Annings. However, new examples of specimens believed or proven to have been collected by Mary Anning, continue to come to light (e.g. Price, 1986; Taylor, 2014; Taylor and Torrens, 1986).

2.2. Alfred Nicholson Leeds

Alfred Nicholson Leeds (1847–1917) (Fig. 3) was by profession a gentleman farmer and 'amateur' fossil collector, who lived at Eyebury near Peterborough in Eastern England. Alfred Leeds, probably initially at the behest of his elder brother Charles Edward Leeds (1845–1912), but later on his own, amassed one of the largest collections of fossil vertebrates (and occasional invertebrates) recovered from anywhere in the British Isles (C.L.F., 1956; Leeds, 1956). During Alfred Leeds lifetime, his collection became renowned across the scientific world, and elements of the collection can now be found in museums in the UK (especially in The Natural History Museum, London (NHMUK, formerly the British Museum (Natural History)), and Hunterian Museum, University of Glasgow), across mainland Europe (particularly in Germany and Austria) and North America (Noè and Liston, 2010).

Alfred Leeds was a quiet family man, in contrast to his more outgoing older brother Charles (Leeds, 1956). Alfred was shy and reserved, even with his sons, and yet he was enthusiastic about fossils and enjoyed showing his specimens to others, whether workmen from the brick pits where he collected, or members of the scientific community. Alfred was not a writer, and therefore did not commit his thoughts or experience to the printed page, but he was more than capable of arguing a point from extensive experience with his specimens. Although not a great reader on the subject of palaeontology, Alfred was patient and skillful with his hands (Leeds, 1956).

Alfred Leeds was the youngest of eight children and the third, and second surviving, son (the eldest of whom died in infancy in 1839), of Edward Thurlow Leeds (1802–1851) and Eliza Mary Leeds (née Nicholson), who married 1837. Edward Leeds lived at Eyebury near Peterborough as the tenant of the Duke of Bedford; Edward Leeds was a noted farmer, considered an excellent judge of cattle,

Fig. 3. Alfred Nicholson Leeds, and his family at Eyebury, near Peterborough. A, Alfred Leeds and his wife Mary Ferrier Leeds (née Fergusson) inside Eyebury, probably soon after their marriage in 1875; B, the Leeds family outside Eyebury, showing Alfred Leeds (left), Mary Leeds (rear centre left) and their five sons (left to right) Edward Thurlow Leeds, Alexander Andrew Ferguson Leeds, Lewis Alfred Leeds, Keith Ferrier Newzam Leeds and Charles Herbert Leeds, taken around 1906; and C, Alfred Leeds shown working in his attic bone room, in a painting by (the later Sir) William Nicholson, painted in 1889. Images copyright the Leeds family, and reproduced with permission; original of C owned by Lewis Leeds, photograph by Nicholas Hall, and reproduced courtesy of Sue Hall (née Leeds).

Please cite this article in press as: L.F. Noè, et al., Mary Anning, Alfred Nicholson Leeds and Steve Etches. Comparing the three most important UK 'amateur' fossil collectors and their collections, Proc. Geol. Assoc. (2018), https://doi.org/10.1016/j.pgeola.2018.09.001

and one of the original guarantors of the Peterborough Corn Exchange built in 1846. Edward Leeds died when Alfred was just four years old, and Eyebury and the other farms managed by the family, were put into trust for the two surviving sons (Leeds, 1956).

Both Charles and Alfred Leeds were educated at Warwick Grammar School, and Charles went up to Exeter College, Oxford University in 1864 (Boase, 1879). This left Alfred to take up management of the Eyebury estate in 1868, despite his heartfelt wish to train as a doctor or surgeon (Leeds, 1956). As part of his studies, Charles Leeds came into contact with John Phillips (1800–1874), professor of Geology at Oxford 1856-1874. This meeting, presumably through Phillips lectures on Geology, inspired Charles to collect fossils from the Oxford Clay close to his home in Peterborough. Hence, during his vacations he began to visit the brickyards that were just beginning to be opened *en mass* in the Peterborough area (Hillier, 1981). Charles collected specimens figured in Phillips publications: belemnites (Phillips, 1865) and the jaws and paddle of a pliosaur (Phillips, 1871). Although Phillips argued strongly that these early specimens should be accessioned to Oxford University, Charles retained them, commenting later that if he had given them up, it would probably have been the end of the Leeds collections (Leeds, 1956).

Alfred Leeds had been a collector and arranger of Natural History and other objects from a young age. Whilst at school in Warwick he built up a collection of birds' eggs, but also collected butterflies at Eyebury, and stamps, all carefully arranged and neatly labelled (Leeds, 1956). Alfred, possibly pressurized by his elder brother, or perhaps out of his own interest, began to collect fossils with Charles. However, Charles' personality was such, that although he had an academic interest in fossils, his enthusiasm waxed and waned with other pursuits. Charles won a Whitworth Engineering Scholarship in 1868 (Johnson and Barwell, c. 1956) which took him briefly to Newark on Trent in 1870, and he then trained as a solicitor (Leeds, 1956). This left Alfred Leeds to farm the Eyebury estate, however, Alfred's heart and soul was not in farming, although at the time it was still a reasonably prosperous business. Hence Alfred Leeds, the born collector and arranger, pursued a career he neither loved nor sought, but found in fossils something away from his day job which could fully engage his passions (Leeds, 1956).

How much time Charles Leeds was able to dedicate to the collection beyond 1869 is not known, however, whilst Charles pursued various careers: initially as an engineer, and later as a lawyer, across the UK (including in Newark on Trent, Bury St. Edmunds, Westminster and York), Alfred Leeds continued quietly and selflessly collecting fossils. Charles retained an active interest in the collection, as evidenced by the visit of Harry Govier Seeley (1839–1909) in 1874 (Seeley, 1874b; Leeds, 1956). This contact probably came as a result of Charles work in Bury St. Edmunds, close to Cambridge where Seeley worked for Adam Sedgwick (1785–1873) in the Woodwardian (now Sedgwick) Museum, possibly as a result of one or more visit(s). Hence, it is almost certain that academics such as Harry Seeley were invited to view, and publish on, the growing collection at Charles, rather than Alfred's, instigation (Leeds, 1956).

In 1887, Charles Leeds emigrated to New Zealand for unspecified health reasons, which left the fossils solely in the hands of Alfred. With Charles having made initial contact with the British Museum (Natural History) (now The Natural History Museum) in London, Alfred Leeds continued to build strong relationships with individual academics, which blossomed into a mutually beneficial working relationship. In 1912 Charles Leeds died (Anonymous, 1912), and by this time Alfred Leeds health was also declining. Having suffered for some time from bronchitis and heart trouble, Alfred Leeds died of heart failure at Eyebury in 1917 (Smith Woodward, 1917), and is buried in the family plot in Eye cemetery.

2.2.1. The Leeds collections

The Leeds Collection (c. 1867-1917) (Fig. 4) is usually divided into two sub-collections (Leeds, 1956; Woodward et al., 1904), and will therefore be referred to here as the 'Leeds Collections'. The First Collection (c. 1867-1890) was developed from the inception of fossil hunting in about 1867 until May 1890 when the entire collection was purchased 'lock, stock and barrel' by the NHMUK (Leeds, 1956). The fossils of the First Collection, when packed, weighed five tons and payment was made in four instalments from 1890 to 1893 (Woodward et al., 1904). Alfred Leeds passed half of the proceeds from the sale to Charles in New Zealand and this represented the end of the joint First Leeds Collection. This clear out represented a welcome new start for Alfred, as his attic bone rooms had become seriously congested with specimens (Leeds, 1956). However, the Second Collection (1890–1917) began almost immediately, with the first specimens added before the First Collection left Eyebury. Alfred Leeds then continued collecting until his death in 1917 (Smith Woodward, 1917).

The Leeds Collections fossils were derived from inland exposures of the Middle Jurassic Callovian and Oxfordian, Lower (now Peterborough Member) and Middle (now Stewartby Member) Oxford Clay Formation from approximately 166-157 Ma (Cohen et al., 2013; updated 2018-08). Fossils were recovered from a wide range of brick pits in and around the villages of Dogsthorpe, Eye, Fletton, Whittlesea and Yaxley, close to Peterborough in Eastern England. It is clear from Edward Thurlow Leeds (1877–1955) account that the Leeds Collections fossils were derived from all levels within the clays (Leeds, 1956) below the overlying topsoil, Quaternary gravels and 'callow' (the name for the weathered topmost clay) down to the 'Gryphaea bed' (now Bed 10, Peterborough Member, Oxford Clay Formation). Hence, it is not true, as is sometimes stated (e.g. Martill and Hudson, 1991; Martill et al., 1994), that Leeds fossils were most commonly found in Bed 10, as they are today due to the mechanical working of the clay pits.

The Leeds Collections consist predominantly of marine vertebrates (ichthyosaurs, plesiosaurs, crocodiles and fish), supplemented by rare dinosaurs, and exceedingly rare pterosaur material (Noè and Liston, 2010). Some of the commonest specimens were the ichthyosaur *Ophthalmosaurus* and the crocodilian *Metriorhynchus*. Of the plesiosaurs, the favourites of Alfred Leeds, specimens of *Cryptoclidus* were the most common, although the head was rarely complete. Of the pliosaurids the small genus *Peloneustes* was the most common, whereas the larger genera *Simolestes* and *Liopleurodon* (at the time called *Pliosaurus*) were rare, especially more complete specimens. Fish were common finds, especially *Lepidotes*, as were broken and bitten bones. Occasional large coprolites, stomach contents, and a single specimen attributed to a fossil egg (Woodward et al., 1904; Anonymous, 1923; Liston and Chapman, 2014) were also recovered. The collections include some invertebrates, such as belemnites, ammonites, brachiopods and crustaceans (e.g. Carter, 1886; Phillips, 1865), which, although common in the Oxford Clay were not often collected, except perhaps in the early years. Pleistocene fossils from the overlying gravels, such as an elephant tusk now in the Sedgwick Museum, Cambridge, were also occasionally collected (Leeds, 1956).

Key specimens from the First Collection include a number of holotypes and published specimens, including: the holotype skeletons of *Muraenosaurus* and *Ophthalmosaurus*, the tail of the giant pachycormid fish *Leedsichthys*, an incomplete skeleton of *Cetiosaurisus* - the most complete sauropod skeleton known from the UK at the time, and a growth series of the plesiosauroid *Cryptoclidus* (Seeley, 1874c; Andrews, 1895b; Smith Woodward, 1905; Liston and Noè, 2004). The Second Leeds Collection included numerous important specimens, such as an almost complete skull of the pliosaurid *Liopleurodon*, the holotype of the pliosaurid

Please cite this article in press as: L.F. Noè, et al., Mary Anning, Alfred Nicholson Leeds and Steve Etches. Comparing the three most important UK 'amateur' fossil collectors and their collections, Proc. Geol. Assoc. (2018), https://doi.org/10.1016/j.pgeola.2018.09.001

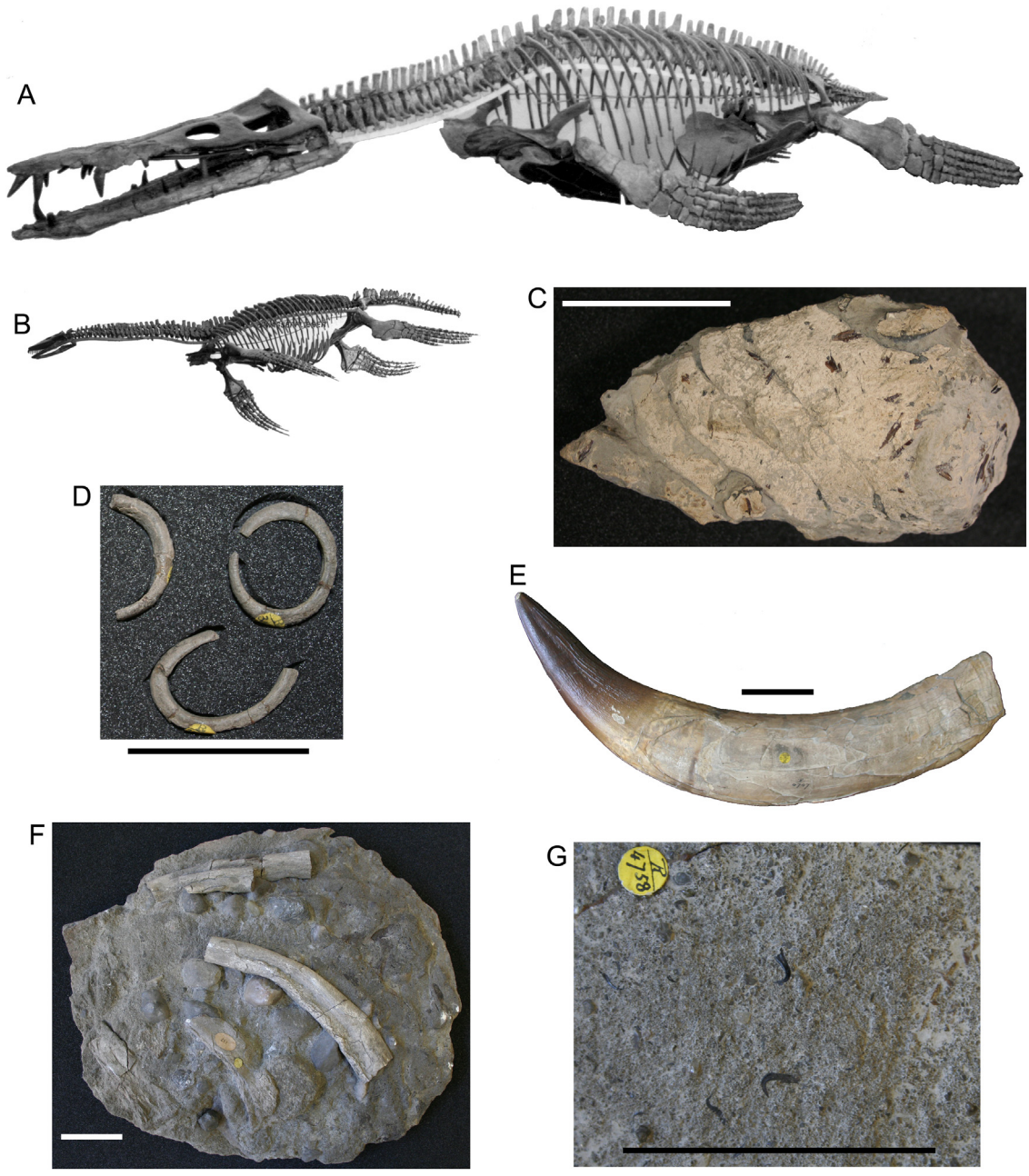

Fig. 4. Examples of fossils collected by Alfred Nicholson Leeds. A, a substantially complete display-mounted skeleton of the pliosaurid *Liopleurodon ferox* (although much of the skull is reconstructed, (Paläontologische Sammlung, Fachbereich Geowissenschaften, Eberhard Karls Universität Tübingen, Germany (GPIT) uncatalogued); B, a display-mount of the plesiosaurid *Cryptoclidus oxonieneis* (GPIT uncatalogued); C, a coprolite, possibly from a shark or marine reptile but currently unattributed to taxon, showing undigested remains (dark areas) and spiral structure (GPIT uncatalogued); D, tracheal rings of the crocodile *Steneosaurus leedsi* (NHMUK R3169); E, the largest example of a tooth of the pliosaurid *Liopleurodon ferox* collected by Alfred Leeds (NHMUK R4747); F and G, examples of stomach contents of marine reptiles, F, contains numerous gastroliths between the ribs (NHMUK R3317) and G, attributed to the pliosaurid *Peloneustes philarchus*, preserves small gravel and sand grade gastroliths mixed with the hooklets of teuthoids (NHMUK R4748). A, B shows how skeletons from the Oxford Clay Formation could be successfully mounted in three-dimensions. Scales: A, approximately 5.3 m in length; B approximately 3.75 m in length; C–G, scale bars represent 50 mm.

Simolestes, and preserved tracheal rings of the crocodilian *Steneosaurus* (R3169, *Mycterosuchus* of Andrews, 1913), and an egg attributed to a reptile donated to the NHMUK in 1898 (Andrews, 1897,1909a,b,1913; Woodward et al., 1904).

The number of specimens collected by the Leeds brothers is not known with certainty. A few elements from the First Collection were sold or donated to institutions other than the NHMUK. The entire First Collection was inventoried by Henry Woodward (1832–1921) bone-by-bone before it was acquired by the NHMUK (Liston and Noè, 2004; Noè, 2009; Noè and Liston, 2010). However, quantifying the size of the Second Leeds Collection is much more difficult, because specimens were sold as they were collected, especially to Bernhard Stürtz (1845–1928) of Bonn, who was introduced to Alfred Leeds by the NHMUK in 1897, and who bought specimens up until 1911. Alfred's son, Edward Thurlow Leeds, estimated the second collection was one-and-a-half to two times the size of the First Collection (Leeds, 1956), but our feeling is this is likely to be an underestimate.

Today, the Leeds Collections are widely distributed across a range of scientific institutions in Europe and North America. Alfred Leeds had an agreement that gave the NHMUK first refusal for any new or unusual specimens. This led to the presentation of

Please cite this article in press as: L.F. Noè, et al., Mary Anning, Alfred Nicholson Leeds and Steve Etches. Comparing the three most important UK 'amateur' fossil collectors and their collections, Proc. Geol. Assoc. (2018), https://doi.org/10.1016/j.pgeola.2018.09.001

vertebrate specimens to the NHMUK in 1888 and 1889, the presentation of invertebrates during the period of 1885–1913, annual purchases in 1894–1899 (including the First Collection), and eight subsequent purchases from 1901 to 1914 (Woodward et al., 1904; Leeds, 1956). From the Second Collection, there were significant sales from 1897 to 1911 by Alfred Leeds to Stürtz, with much material from before 1905 re-sold to Tübingen University. Following Alfred Leeds death, which occurred during the Great War (World War One), the fossils initially remained at Eyebury. However, following the end of the war on 11th November 1918, Alfred's only farming son, Alfred Lewis Ferrier Leeds (1883–1918) died unexpectedly in December, and the remainder of the Second Collection had to be urgently disposed of (Leeds, 1956). A letter was circulated to museums, stressing the uniqueness of the material, but austerity following the war meant only small amounts were sold to the University of Liverpool, and Cardiff, Kendall and Liverpool Museums (e.g. Neaverson, 1935). However, this left a large proportion of the fossils unsold. Finally, in August 1919, an agreement was made with the Hunterian Museum, University of Glasgow to receive the majority of the remaining material, with a small residue discarded; Mrs Leeds was particularly happy about this, as she had grown up and married in the city (Liston, 2006). Hence, in September 1919 the last fossils departed, and more than 100 years of Leeds family tenure at Eyebury ended. A final, small purchase of Alfred Leeds favourite and unique items was made by the NHMUK from Mrs Leeds in 1920.

2.3. Steve Etches

Steve Etches (b. 1949) (Fig. 5) is the most important and well-known non-commercial fossil collector in the UK today. He has widespread contacts with the palaeontological community (both scientific and non-scientific), the museum world, and amateur and professional collectors across the UK. Steve is a plumber by trade, married, and he and his wife Sue have three children. Steve is a self-confessed loner, who is happy in his own company; however, that is not to say he is solitary or shuns the company of others. On the contrary he is extremely amiable, with a wide range of friends and colleagues in the local and regional geological, fossil collecting and academic communities. As a collector Steve can be secretive (as indeed Steve perceives most collectors, Etches and Clarke, 2010), although he is always willing to show interested groups or private individuals his specimens, and is keen to impart his knowledge of collecting and about his collection to specialists and non-specialists alike. Steve is hard-working and has developed a systematic approach to fossil collecting, he is fascinated by the fossils he finds, and his interest has grown with time and discoveries. Steve continues to actively collect fossils today.

Steve Etches was born on the outskirts of Bournemouth, near Throop in 1949, the fourth of five children. His father was a well-travelled commercial and industrial photographer, and his mother a housewife. As a child Steve was a hunter and collector, and at the age of five found his first fossil, a flint echinoid, whilst searching his back garden. This fossil made its way into his mother's button box, and thereby survives to this day. As a youngster Steve hated team games, saw no point in sports, and had little interest in school, except metalwork and English where he excelled. As a result, Steve spent much of his childhood searching for items from the natural and human worlds: birds' nests, badger setts, sea shells, or fascinating rocks and minerals. He undertook bird watching (with an old pair of U-boat binoculars given to him by his father), night fishing, shooting and star-gazing, and he would search for, and find, lost or discarded items such as coins, or spent (and sometimes unspent) gun cartridges. From an early age Steve had a keen eye,

Fig. 5. Steve Etches and his collection. A, B, Steve collecting fossils in the field from the foreshore close to Kimmeridge; C, Steve and part of his collection as formerly displayed in his purpose built museum in Kimmeridge; and D, Steve demonstrating preparation techniques using a compressed air driven airpen to young visitors to his collection. Images: Terry Keenan, copyright The Etches Collection, MJML.

Please cite this article in press as: L.F. Noè, et al., Mary Anning, Alfred Nicholson Leeds and Steve Etches. Comparing the three most important UK 'amateur' fossil collectors and their collections, Proc. Geol. Assoc. (2018), https://doi.org/10.1016/j.pgeola.2018.09.001

and his searching developed in him the 'hunters spirit', which fired his imagination and interest in a way school was largely unable to do.

When his father was working away from home, Steve would often act as an unpaid Photographic Assistant. After carrying out a photographic shoot, Steve and his father would pack up the equipment, and if time allowed they would head for a remote beach where Steve could collect pebbles, crystals or anything else he could find. During family outings and holidays, Steve was not one for lazing in the sun, lying on the beach, or playing in the sea like the rest of the family, but saw an opportunity to explore a new locality, leading on one occasion to the Kimmeridge Clay in which he discovered brachiopods, selenite crystals, oyster hash and echinoid spines (Etches and Clarke, 2010). With little money to spend on hobbies, Steve had to rely on a tilers hammer given to him by his father to satisfy his geological curiosity, and headed to wherever he could find specimens: school, beach, heath or piles of roadside gravel. This hunting developed in him a sense of

Fig. 6. Examples of some of the most stunning and scientifically important specimens from the Etches collection. A, a substantially complete pliosaurid jaw (MJML K1), the specimen that started the Etches Collection in 1981; B, a complete specimen of the fish *Lepidotes* (MJML K1943); C, the skull of a pterosaur (MJML K1918); D, an extremely rare dragonfly wing, *Kimmeridgebrachypteraeschnidium etchesi* (K619); E, a juvenile ichthyosaur (MJML K1747), probably a new species, with extensive stomach contents preserved between the ribs; F, an adult ichthyosaur (MJML K1885), probably representing a second new species; G, rare ammonite eggs (MJML K1654); and H, a unique goose barnacle (MJML K1261), one of Darwin's 'missing links'. Images Terry Keenan, copyright The Etches Collection, MJML.

Please cite this article in press as: L.F. Noè, et al., Mary Anning, Alfred Nicholson Leeds and Steve Etches. Comparing the three most important UK 'amateur' fossil collectors and their collections, Proc. Geol. Assoc. (2018), https://doi.org/10.1016/j.pgeola.2018.09.001

enterprise, where time and effort were rewarded by the objects found, and it was unusual for the young Steve not to find something if he looked hard enough (Etches and Clarke, 2010).

Following a break from fossil collecting during his teens and early twenties, his wife Sue took Steve to Wimborne on a shopping trip and led him to a local fossil shop. This re-kindled Steve's latent interest in rocks and fossils, and further encouraged by the enthusiastic shopkeeper, Steve, his family and his brother-in-law began to explore the Dorset coast to collect fossils. The family quickly lost interest, but Steve recognised from visits to the coast and to local and national museums that the Kimmeridge Clay was under-collected and understudied, despite some spectacular finds from the nineteenth century (e.g. [Owen, 1861, 1863,1869; Hulke, 1869a,b,1870, 1871a,b, 1872; Mansel-Pleydell, 1873, 1888). With this information to hand, Steve decided to make it his aim to collect and accurately document the stratigraphy of the Kimmeridge Clay and its fossils (Etches and Clarke, 2010).

2.3.1. The Etches collection

The Etches Collection (Fig. 6), now housed in the Museum of Jurassic Marine Life (MJML, Kimmeridge, Wareham, Dorset, BH20 5PE, UK), is principally derived from the Late Jurassic Kimmeridge Clay Formation, Kimmeridgian and Tithonian stages approximately 157-145 Ma (Cohen et al., 2013; updated 2018-08; Morgans-Bell et al., 2001) of the Dorset coast, UK, although specimens have also been recovered from inland localities such as the Westbury Blue Circle Cement Works, Oday Common, Abbingdon, and other Kimmeridge Clay localities across the UK (Etches and Clarke, 2010). Although Steve has collected fossils for many years, the Etches Collection can be considered to have begun in March 1981 with the discovery of the first parts of a large, virtually complete pliosaurid mandible (MJML K1) from the lower Kimmeridge Clay at Kimmeridge (Etches and Clarke, 1999-2003; Etches and Clarke, 1999). Steve continues to collect today.

The Etches Collection predominantly contains marine invertebrates and vertebrates, but also some terrestrial and flying organisms, and terrestrial plants. The vertebrates include marine reptiles (ichthyosaurs, plesiosaurids, pliosaurids, turtles, crocodilians), and 'fish' of many types (both actinopterygians and chondrichthyans). The marine invertebrates include ammonites, teuthoids, belemnoids, echinoderms, bivalves, brachiopods, gastropods, cnidaria, nautiloids, decapod crustaceans, as well as marine ichnofossils. Rarer terrestrial and flying vertebrates and invertebrates, such as dinosaurs, pterosaurs and insects are also found in the collection, together with a few terrestrial plants (Etches and Clarke, 1999-2003; Etches and Clarke, 1999, 2010). Examples of key vertebrate specimens include substantially complete and beautifully preserved ichthyosaurs (MJML K292, K1009); plesiosaur limb bones with bite marks (MJML K92, K147, K220, K1060); crocodilians (MJML K435, K461, K1485); a chelonian (MJML K1130); pterosaur mandible (MJML K1235), teeth (MJML K596, K612) and limb bones (MJML K445, K631, K1420), some associated (MJML K1597) or articulated (MJML K1026); a 'rhinobatid' ray with soft-part preservation, including claspers (MJML K1281); a complete *Thrissops* fish (MJML K1395, K1440); and unique fish and sharks. Key invertebrate specimens include: numerous zonal ammonites, *Trachyteuthis* (MJML K1032) and *Belemnoteuthis* (MJML K1086); cephalopods in 3-dimensions or preserving soft-parts; ammonite egg sacs (MJML K633, K1058, K1273, K1429, K1486); well-preserved *Eryma* decapods (MJML K422, K760); a goose barnacle preserving colour banding (MJML K1261); and a dragonfly wing (MJML K619) which is unique from the Kimmeridge Clay (Etches and Clarke, 1999-2003; Etches and Clarke, 1999, 2010).

Steve Etches very much sees himself as the rescuer and temporary custodian of his specimens. He does not sell fossils, and has always strongly believed his Kimmeridge collection should remain in Dorset where the specimens were found. To this end, the Etches collection was formerly housed in Steve's private museum, set up at his home in Kimmeridge. The entire collection has now been transferred to a purpose built, multi-million pound Heritage Lottery Fund funded museum, which opened on Friday 21st October 2016. The museum now acts as a permanent public repository for the 2360 specimens (as of August 2018) making up the Etches Collection, and its subsequent additions, which are safeguarded for the nation under the auspices of the charitable Kimmeridge Trust. The Etches Collection is thereby now in a registered museum (MJML), with the specimens cared for under Collections Trust international Spectrum Standards (see https://collectionstrust.org.uk/spectrum/). Museum staff are currently in the early stages of working towards Arts Council Accreditation, which it is hoped will ultimately lead to its formal recognition as an outstanding national collection through the Designation scheme. The setting up of a registered museum in Kimmeridge for the Etches Collection is in many ways the culmination of Steve's life's work, and a major accomplishment for both Steve and the team that worked so hard towards the implementation of this long held vision.

3. Discussion

Here we explore and discuss the lives and work of Mary Anning, Alfred Leeds and Steve Etches. First, we consider some general aspects that made their collections possible; next we explore the motivations of each collector; the unique skill sets developed in order to locate and recover specimens; and their interactions with family, friends and the scientific community. In addition, each collector has been variously acknowledged during their lifetime (and beyond), and has had a lasting, and ongoing, impact on the science of palaeontology. Finally we consider the thorny question of whether Mary Anning, Alfred Leeds and Steve Etches should be considered amateurs or professionals.

3.1. Right place, right time

A consideration of the lives of Mary Anning, Alfred Nicholson Leeds and Steve Etches shows all three lived 'in the right place' and 'at the right time' for exceptional fossil collecting. In terms of place, all three collected from predominantly fine-grained, shallow marine successions, where large numbers of organisms lived (both in terms of original numbers and preserved taxic diversity), and where preservation potential was high. All three localities thereby represent fossil Lagerstätten, and hence allowed the collection of relatively abundant and spectacularly-preserved museum display-quality specimens. However, it is curious to note that all three collected from UK Jurassic successions, and made their names from large marine reptiles. The reasons for this may be many. Prior to the Mesozoic there were relatively few, large, marine tetrapods, although fish had been abundant since the late Devonian and had been widely collected (e.g. the Scottish Orcadian lake system, Andrews, 1982; Newman, 2010). However, it was the spectacularly strange Mesozoic marine reptiles and dinosaurs that captured both the scientific and popular imaginations (e.g. Moody et al., 2010) in a way that the, perhaps more familiar, Cenozoic mammals have largely failed to do. In the UK, Triassic fossiliferous deposits are rare, but this does not explain why similar spectacular private collections have not come from Cretaceous strata, such as the chalk, which is abundantly exposed, fine-grained, fossiliferous, and preserves large marine vertebrates (e.g. Owen, 1850; Smith and Batten, 2002). Despite spectacular finds in Wealden strata (particularly on the Isle of Wight) and the chalk (e.g. the Culland pits), specimens appear to be less common and not so frequently

Please cite this article in press as: L.F. Noè, et al., Mary Anning, Alfred Nicholson Leeds and Steve Etches. Comparing the three most important UK 'amateur' fossil collectors and their collections, Proc. Geol. Assoc. (2018), https://doi.org/10.1016/j.pgeola.2018.09.001

fully articulated: perhaps these Cretaceous deposits will be ripe hunting grounds for current and future UK amateur collectors to exploit.

Time was also an important factor in the development of the Anning, Leeds and Etches collections. By the 1790s Lyme Regis had become a popular seaside destination for both the gentry and the wealthy middle classes, with an increasing number of tourists visiting Lyme as a healthy bathing destination for both the able bodied and the infirm (Anonymous, 1813). In addition, Lyme Regis became a popular seaside resort for the wealthy with a predilection for collecting natural history objects, including fossils. Moreover, Lyme Regis just happened to be situated where richly fossiliferous deposits were common (Lord and Davis, 2010), and these fossils could be discovered and collected by the initiated and industrious from the constantly eroding cliffs. Lyme thereby became important for the new sciences of geology and palaeontology which attracted researchers and University professors, allowing the Anning family to sell fossils to both affluent and academic visitors.

Alfred Leeds also lived at an auspicious time for fossil collecting. Although bricks had been made for generations in and around Peterborough (Collier, 1966), the introduction of the dry press method industrialized and sped up brick-making, and meant manufacturers began to exploit the deeper layers of the Oxford Clay for raw materials (Noè, 2009). This is in contrast to the times of the Peterborough fossil collector Henry Porter (1832–1868), who was only able to collect from the puddled surface clay ('callow') that was previously used for brickmaking (Porter, 1861). The new techniques, together with changes in taxation on brick manufacture, and the self-firing nature of the Oxford Clay (and hence the introduction of the Hoffmann process), made brickmaking considerably more profitable than farming (Noè, 2009; Noè and Liston, 2010). Hence much land around Peterborough was turned over to brick manufacture. In addition, in the times of Alfred Leeds, the clay was still largely worked by hand, allowing Leeds to collect before the widespread mechanization which commenced early in the 20th Century and led to loss of the majority of fossil specimens (Leeds, 1956).

For Steve Etches, a key parameter in the initiation of his collection was the recognition that the Kimmeridge Clay and its fossil fauna and flora had been underexploited for more than a century (Etches and Clarke, 2010). In addition, UK laws that make many coastal exposures Crown (i.e. U.K. Government) property, and therefore public land on which collections can be made without landowner permission, was also key, although other designations and restrictions may apply. Around Kimmeridge, the Kimmeridge Bay foreshore is owned by the Smedmore Estate, and is also a Site of Special Scientific Interest (SSSI). To the east of Kimmeridge Bay, including the areas of Freshwater Steps (also an SSSI), Egmont Bight and up to and including Chapmans Pool, the foreshore is Crown Property, but the cliff exposures are owned by the Encombe Estate. Hence, obtaining relevant permissions to collect has also been key to the development of the Etches Collection.

3.2. Motivations

Mary Anning, Alfred Leeds and Steve Etches have all been highly motivated fossil collectors. This can be seen by the number of years they collected fossils (Mary Anning 37 years, Alfred Leeds 42 years, and Steve Etches 37 years and counting), and the often arduous conditions under which they worked. The personalities of the collectors were also crucial to their successes: each had an innate passion for collecting, and an instinctive scientific focus to their thinking without the need for formal academic training. In addition, all three recognised, and effectively exploited, a fossil collecting niche more successfully, and with greater commitment, than others around them.

For the Anning family, fossils were a business and means of financial support. These fossils, collected from the Lyme Regis cliffs, were sold on a table outside their home close to the prison (Roberts, 1834), and at the coach stop and near local inns (either the Golden Lion and/or the Three Cups, Anonymous, 1813). Hence, it is likely that from an early age Mary and Joseph were taken out on fossil hunting trips by their father, and in this way fossil hunting became part of the Annings everyday lives. Following Richard's death, the Anning family were left with no breadwinner for the household, considerable debts, and no known regular income stream (Torrens, 1995). For Mary, on her way home the day after her father's funeral, a chance encounter on the beach with a lady who paid her half a crown ($12^1/_2$ pence) for an ammonite she had just found, was also an important impetus to continue collecting (Roberts, 1834; Grant, 1827; Bowles, 1828).

The relatively high value of the large, spectacular and scientifically important specimens sold by the Anning's may also have made fossil hunting attractive as a means of income. However, this is one aspect of the Annings fossil business that is often overlooked or downplayed: the relative value of some of the fossils they found (however, see Taylor and Torrens, 1986), for instance, the ichthyosaur discovered and excavated by Joseph and Mary Anning in the winter of 1811/12 (now NHMUK R1158) was sold to Henry Hoste Henley (1766–1833) for 23 GBP (Roberts, 1834). Although the annual income of Richard Anning is not known, we can get some idea by comparison to the Colquhoun Social Tables (see Lindert, 1982). As a cabinetmaker, Richard Anning can be considered to have belonged to category C: industry and building: 'Artisans, handicrafts, mechanics, and labourers, employed in manufactures, buildings, and works of every kind' (Lindert, 1982). Being aware that these are average figures, and that regional variations in wages occurred (generally lower in rural areas such as Dorset, Torrens, 1995), we can surmise an approximate, annual income of less than 55 GBP per year for Richard Anning in around 1800; we note this estimate compares favourably to the 25 GBP annual annuity awarded to Mary Anning in 1838 (Torrens, 1995). This means the relative value of this first ichthyosaur specimen was probably equivalent to more than six months' wages for the Anning family, and the 200 guineas (210 GBP) paid for the exceptional 1830 Plesiosaur represented almost four years' wages - considerable sums.

It is possible that prior to Richard Anning's death in 1810 the family had found and sold significant fossil specimens (e.g. to Lieutenant-Colonel Thomas James Birch, c. 1768-1829), however, Richard's death left the Anning family in dire need and on Parish relief (Torrens, 1995). This poverty undoubtedly drove the Annings to explore the Lyme and Charmouth sea cliffs for fossils to sell, as at this stage in their lives, even a few pennies acquired from common fossils such as ammonites and belemnites would have been welcome. However, the unsteady but not inconsiderable income generated by rare but spectacular finds eventually permitted the Anning family to pay off their father's debts, assist Joseph in setting up in business as a cabinetmaker, and to purchase a house and fossil depot in Broad Street (Grant, 1827; Roberts, c1830). Hence, by 1827, the Anning family had both literally and figuratively moved up in the town. Thereby, Mary and her family had managed to work their way out of grinding poverty by selling fossils.

The Leeds Collections were initiated through Charles Leeds interaction with John Phillips in Oxford University. However, the driving force for Alfred Leeds collecting seems to have been his personal interest, with his passion for fossils driven by his love of puzzles and his innate scientific bent (Leeds, 1956). Although farming was his day job, Alfred Leeds heart was never in working the land, so collecting fossils became his solace and interest. It was

Please cite this article in press as: L.F. Noè, et al., Mary Anning, Alfred Nicholson Leeds and Steve Etches. Comparing the three most important UK 'amateur' fossil collectors and their collections, Proc. Geol. Assoc. (2018), https://doi.org/10.1016/j.pgeola.2018.09.001

probably this personal interest, rather than any external stimulus, that explains why such an important collection did not reach scientific attention more rapidly.

By the 1880s, when Alfred Leeds collection had begun to come to scientific and public attention, he was approached by the NHMUK to sell. Initially Alfred resisted, but ultimately relented, probably as a result of the late eighteenth century agricultural depression, and the reduced profitability of farming (Perry, 1972; Turner, 1992; Hunt and Pam, 2002). Hence the sale of the First Collection may have been prompted by the need for money. By May 1889 Alfred had thereby begun to see his fossils in a different light: as an opportunity 'to turn his hobby to practical account' (Leeds, 1956: p.90). So, Leeds continued to collect, but apparently began to rely more heavily on selling fossils to supplement his farming income, as seen by regular sales to the NHMUK, the auction of items in August 1896 (Chalmers-Hunt, 1976), and the volume of sales to the German fossil dealer Stürtz (Leeds, 1956). Ultimately the collection may have been amassed for financial reasons, rather than simply the love of collecting. This therefore suggests a gradual change in the reasons for collecting: initially for scientific reasons with Charles Leeds, later the personal interest of Alfred Leeds, and later still a source of financial support for the Leeds family at a time when farming had become less profitable.

Steve Etches, like Mary Anning, had hunted for fossils amongst other things from an early age. However, his adult return to fossil collecting was prompted by his wife and a visit to a local fossil shop, and the encouragement he received from its owner. This led to renewed interest in fossil collecting, which was further developed by a will to discover more about the subject through attendance at evening lectures, and by joining local and regional geological societies and associations. Although Steve had been collecting fossils for some time before 1981, the real impetus for the formation of the Etches Collection was the discovery of the first part an extremely large pliosaurid mandible (MJML K1), still one of his largest and most spectacular fossil finds. This fired Steve's imagination, and set off his systematic fossil collecting career: and what a career in this fascinating topic. For Steve, fossils from the Kimmeridge Clay are his life's work.

3.3. Collection methods

Here we consider the practicalities of discovering fossils, and how this was undertaken. Building up a world-class fossil collection involves a series of phases. The discovery of fossils is followed by the physical recovery of the specimens and their removal to a safe storage location. This is typically followed by preparation of the specimen to remove excess matrix, the reuniting of broken elements and mounting and display of the newly acquired fossils, whether for personal enjoyment, exposition to others, or for sale. These phases are augmented by curation of the collection, the care and storage of the specimens, and the recording and management of the data associated with the specimens.

3.3.1. Discovery

Finding fossils requires the trained, expert eye of one who is intimately familiar with the clays, mudstones and limestones of the geological formation explored. Repeated walks along cliff and foreshore exposures, or regular visits to clay pits, permits recognition of the constant changes that have occurred along any particular stretch of coastline or working quarry. This requires familiarity with the local tides and weather conditions, chatting to workmen, or understanding of the reaction of rock to a hammer or chisel blow. The fossil hunter's eye is developed through constant searching, as well as an innate ability to observe and persevere, no matter what the weather, whether or not fossils appear to be present, as well as a lot luck thrown into the mix.

Mary Anning and Steve Etches both relied on their skill at being able to locate fossils in the sea cliffs of the Dorset coast. This entailed frequent long hours walking the cliffs, ledges and foreshores looking for the often tiny evidence that would indicate a fossil is present. The most fruitful times occur in the winter months, when storms generate landslides and cliff falls and movement of surface materials is more common. This was especially true after the winter storms of 1824, and 1979-80 (Etches and Clarke, 2010; Roberts, c. 1830). However, even with detailed knowledge of local tides and the ever changing shoreline, collecting fossils from steep cliff localities remains an inherently risky occupation. The sea can turn more quickly than expected and landslides can occur in unstable cliff sections. For example, in 1833 Mary Anning nearly lost her life and her dog Tray was killed in front of her by a cliff fall (McGowan, 2001). Anning is also known to have purchased specimens from other collectors to re-sell (Taquet, 2003; Vincent and Taquet, 2010).

Alfred Leeds on the other hand rarely, if ever, spent time actually looking for fossils. He relied on the workmen, overseers and owners of the brick pits to inform him of new finds, backed up by regular visits to remind the men he still existed and continued to collect (Leeds, 1956). This would occasionally result in a summons by letter, postcard or telegram, followed by rapid travel on a horse drawn dog-cart to the relevant pit. Specimens were typically exposed by hand digging of the clay using a 36 lb crow bar, which would have a distinctive ring when striking bone or other fossil material (Noè, 2009). However, this method of extracting the clay, with its constant jarring of the subsurface layers, was not kind to the specimens, which were almost always discovered fragmented. Although Alfred always preferred to collect specimens in situ, this was not always possible without interrupting the work of the pit. However, prior to the mechanized grinding of the clays, fossils would result in the bricks exploding due to differential heating during firing. Hence the workmen were paid a bonus of 1 *s* (one shilling; 5 pence today) for a full 'bolt bucket' (a 'Devils Thunderbolt' was the local name for belemnite guards). For good or unusual specimens Alfred would pay the men more (typically 1 crown; 5 *s* or 25 pence today).

For Steve Etches, searching for fossils has involved systematic walking along coastal exposures, methodically breaking open concretions, and spotting changes along the coastline that indicate a new fall or movement of sediments which may reveal new exposures (Etches and Clarke, 2010). Exploration of every horizon, including those above and below the strand line is an essential element for getting the collectors 'eye in'. Patience is also a key factor, with regular visits of at least once a week to understand the dynamics of the coastline, where spotting small changes may lead the collector to a productive spot. Patience is also required when walking for hours along the shore, whilst waiting for the next storm, or for a cliff face or exposure to release the remainder of a specimen visible, but not safe to collect. This is illustrated by an Etches Collection pliosaurid limb bone (MJML K2) recovered over a period of six years; the first part recovered in 1983, with the remainder collected in 1986 and 1989. Steve Etches also stresses the importance of recovering all fossils, not just the superficially spectacular specimens, as well as checking for the evidence other collectors' failures, which can result in finding missed parts of a (now incomplete) specimen.

3.3.2. Recovery

For all three collectors, once a specimen had been located it needed to be rapidly and efficiently collected. In the cases of Mary Anning and Steve Etches, specimens had to be speedily removed before they were damaged or destroyed by the action of the sea, or lost or damaged by other fossil collectors or the curious. In the early years, prior to 1833, Mary Anning is known to have left her dog Tray

Please cite this article in press as: L.F. Noè, et al., Mary Anning, Alfred Nicholson Leeds and Steve Etches. Comparing the three most important UK 'amateur' fossil collectors and their collections, Proc. Geol. Assoc. (2018), https://doi.org/10.1016/j.pgeola.2018.09.001

to guard specimens prior to recovery. However, relatively little is known about how Mary Anning actually recovered her fossils. Presumably, as with Steve Etches, relatively small specimens such as ammonites or small groups of bones could be excavated by hand, relatively easily protected, and carried in a rucksack or day bag. However, larger specimens, such as substantially complete ichthyosaurs or plesiosaurs, required considerably greater logistics. The fossils, if found in situ rather than as loose blocks on the shore, needed to be removed from the rock and then transported. It is known the Annings used local workmen to help excavate some specimens (Roberts, 1834), and on at least one occasion when a specimen was considered impossible to extract, the work was undertaken by Thomas Hawkins (Hawkins, 1834) who presumably had greater assets at his disposal to enable the work to be completed.

For Alfred Leeds it was imperative he did not interrupt the clay getters work, or impede the flow of clay to the brick kilns. Occasionally, during one of his 'rounds' of the brick pits, or following notification by telegram or letter, Alfred Leeds would hastily make his way to the respective pit, all or part of a specimen would remain in the ground (Leeds, 1956). Alfred would rapidly but carefully excavate the clay, splitting it with a kitchen knife. Leeds excelled in collecting all bone fragments, even when the wet clay smeared across the surface, and clay and bone merged together. He did not like uncovering too much of a skeleton at once, even if this was possible. However, frequently he was only able to work on the exposed clay benches, and would sometimes have to wait weeks or months to complete an excavation. Alfred would carefully collect all fragments, which may involve a search over a considerable area, for any missing parts. Wherever possible the associated bones were wrapped in individually numbered parcels, but if there was insufficient time, elements of a skeleton would be thrown into a box or roughly packaged (Leeds, 1956). Alfred particularly disliked collecting ichthyosaurs, because of the many separate bones, loose teeth, numerous ribs and paddle bones, many of which looked similar. However, Alfred's careful methods of collection resulted in some fantastically complete specimens, although he was frustrated when small fragments had been missed, such as individual scales from an almost complete fish.

For Steve Etches most specimens need to be removed from the foreshore before destruction by the natural elements. Recovery may have to occur on a low or turning tide, and collection may necessitate working on a rising tide or wading through knee-deep water with a specimen. Large specimens may need to be 'walked' up the shore face to above the high tide line, and collected later. Steve is creative in moving fossils. He has used two ladders secured together with ropes as a kind of stretcher, and enlisted the help of friends and relations to move large specimens, with a great deal of sweat and toil along the way. For Steve, and presumably our other collectors, trial and error has led to the destruction of some early finds, especially from the shock waves formed during the use of hammer and chisel. Use of a cold chisel and bolster to cut a groove around a specimen, starting with a groove chiselled whilst angling the tool away from the specimen, then later towards it (see https://www.youtube.com/watch?v=WN0KTiJbskI). Removal is achieved by driving a wedge or chisel beneath the specimen to release the entire slab, fossil and all. Careful checking of broken edges is essential to ensure none of the specimen is missed. For instance, a row of scales may indicate the presence of a complete fish, so it is necessary to leave sufficient space around the visible fossil remains to ensure the entire specimen is collected (Etches and Clarke, 2010).

3.3.3. Preparation, preservation, repair and mounting

The techniques used to prepare and repair fossils have changed considerably between the times of Mary Anning and Steve Etches. Remarkably little is known of the methods employed by the Anning family to prepare and mount their specimens. However, it is reported that Anning would mount specimens on a frame (Taylor and Torrens, 1986; Torrens, 1995), possibly in a similar manner to those employed by Thomas Hawkins (Taylor, 1989). For Alfred Leeds, the slow and steady job of cleaning and preparing fossils was concentrated in the evenings of the winter months. Leeds would spend many hours carefully washing all the adherent clay from his specimens. Fragmented fossils that could not be packed separately during recovery had to be 'rough sorted' and organized into common elements, although this was undertaken with remarkable skill and rapidity, even when one bone may consist of numerous broken parts (Leeds, 1956). The difficulty of this task can be illustrated by one plesiosaur coracoid which consisted of no less than 120 pieces, and the skull of *Liopleurodon* (NHMUK R2680) or the tail of *Leedsichthys* (NHMUK P10000) which consisted of many more fragments. Once organized, many hours and days were spent reuniting the bones, wherever possible adhering even the tiniest fragments. Repairs were undertaken by means of specially prepared shellac-based glue, possibly with a little sand as a 'gap filler' to strengthen a joint. When repairs were in full swing, every available surface at Eyebury would be covered by bones, although these would have to be removed to the attic 'bone rooms' when visitors came (Leeds, 1956). The specimens were originally mounted on paper covered wooden boards for display in the attic 'bone rooms'.

Steve Etches has a whole series of modern preparation techniques unavailable to Anning or Leeds, and his skill and techniques have improved with time and experience. Steve rapidly realised that fossils do not simply appear out of the clay or concretions perfectly prepared at the blow of a hammer. Early techniques included removal of matrix using knife blades, chisels, pins or any other implements to hand. Following acquisition of a book on palaeontological techniques (Rixon, 1976) detailing the practices used by the NHMUK, Steve was able to enhance his preparation methods. Firstly, specimens collected from sea shore exposures need to be washed free of salts, which would otherwise damage the fossils by haloclasty. Specimens are almost always recovered wet, and need to be dried sufficiently slowly that the clays do not lose their internal strength, and crack or shatter the contained fossils. Nevertheless, when first recovered specimens are frequently unstable and need consolidation to prevent loss or damage. Steve sparingly uses cyanoacrylate (super) glues due to their strength and rapid bonding, as well as modern consolidants such as Paraloid B69 and B72.

For Steve, preparation is undertaken using compressed-air driven airscribe (Fig. 5D) and airabrasive machines with different powders; sodium bicarbonate for softer material and more cutting iron powders for harder substrates, all with inbuilt dust extraction. More precise preparation can be undertaken under a binocular microscope. Steve also occasionally uses acid preparation (with suitable acid removal precautions afterwards) or the resin transfer method to provide support and visibility for an eroded specimen which can then be fully prepared from the underside. Very occasional gap-filling is undertaken using Milliput epoxy putty or plaster of Paris. For consolidation Steve uses reversible Paraloid. Originally, large specimens on matrix slabs were mounted using plywood backing to prevent distortion, but are now reinforced with glass fibre rods and coated with four layers of fibreglass matting and resin. This latter technique produces a lightweight mount of great strength, and allows the specimen to be dismounted if required. Moderate sized specimens are supported by Plastazote foam, with smaller specimens, such as individual ammonites, mounted using a pin clasp.

3.3.4. Display

Mary Anning, as a commercial fossil dealer, was interested in selling specimens, so needed to display fossils in her shop and

Please cite this article in press as: L.F. Noè, et al., Mary Anning, Alfred Nicholson Leeds and Steve Etches. Comparing the three most important UK 'amateur' fossil collectors and their collections, Proc. Geol. Assoc. (2018), https://doi.org/10.1016/j.pgeola.2018.09.001

advertise them to potential customers. This was done both in the Anning fossil shop and by contacting potential purchasers in writing (e.g. Price, 1986).

The Leeds Collections specimens were initially stored in the attic at Eyebury after Charles was bidden by his mother to move the bones to tidy the house in the 1860s (Leeds, 1956). Two attics ultimately became Leeds 'bone room museum', with the specimens mounted presumably for Leeds own viewing pleasure. Charles Leeds introduced his scientific friends to the collection, and it was presumably in these 'bone rooms' where Charles transcribed the oral description of *Muraenosaurs leedsi* for Seeley (1874b). Alfred Leeds very much enjoyed talking about his collection to Eyebury visitors and was always happy to show his fossils to the owners and workers in the brick pits from which his collection was derived. However, this had to be undertaken on a Saturday afternoon, as the only free time available for the workmen (Leeds, 1956). With these visits he attempted to illustrate his fossil finds and their importance, and to fan any spark of interest he saw in the workmen, with the aim to encourage them to inform him promptly of any new finds. The bone rooms were also where Henry Woodward catalogued the First Leeds Collection prior to the sale to the NHMUK, and later presumably acted as a sales point for the NHMUK, Stürtz and other purchasers.

Steve Etches constructed his own, purpose built and personally financed, private museum, with display cabinets and lighting designed to best display his specimens. Wherever possible Steve uses museum grade materials, but is also inherently practical, rather than trying to slavishly adhere to current 'best practice'. Steve's museum is climate controlled, with monitored and regulated relative humidity to prevent moisture driven volumetric changes and the ravages of pyrite decay. LFN well remembers his first (1995) meeting of the Symposium of Palaeontological Preparators and Conservators, organized by David Brown and held in Newcastle, where Steve gave a presentation about his collection. Following this talk, it was commented by William Lindsay, then head of the Conservation Unit at the NHMUK, that Steve was able to keep his collection in more stable environmental conditions than the UK National Museum could for the majority of their collections - a considerable scientific achievement. Today, the Etches Collection is housed in a purpose built museum in Kimmeridge.

3.3.5. Curation

Almost nothing is known of the curation and record keeping methods of the Anning family, although a few letters offering specimens for sale (e.g. Price, 1986), or requesting delayed payment (Torrens, 1995) have survived. However, as the Annings were collecting fossils at the very birth of vertebrate palaeontology (Taylor, 1997), the level of data recorded for each specimen was much lower than would be considered minimal today. Alfred Leeds kept several notebooks with detailed records of pit numbers from which his specimens were recovered, depth of discovery, and the bones associated with any individual specimen (Noè, 2009). This was in part to be able to return to a pit to collect the remainder of a specimen that was incompletely exposed or collected. However, the details of the pit numbering scheme, which also often appeared on the labels kept with the specimens, are now somewhat cryptic, and in the majority of cases still need to be deciphered. Work is ongoing to resolve this potentially valuable information.

Steve Etches recognised early in his collecting career that the only way to be able to repeatedly find fossils, and to understand the relationships between the strata (and hence time) and his fossil finds, was to keep detailed written records. This record keeping requires a comprehensive working knowledge of the geological horizons from which fossils were collected. This latter point undoubtedly also pertained to Mary Anning, and possibly somewhat less so to Alfred Leeds who spent less time 'on the ground' searching for specimens. Steve writes a specimen label for each specimen in indelible, light resistant ink. He also keeps a card (or computer) record for each specimen, recording collection number, identification, parts of the specimen, exact location with grid reference and geological horizon, date collected and any other relevant notes (Etches and Clarke, 2010). This record keeping has to be done immediately, or as soon after as possible after collection, as the human memory fades remarkably quickly with time.

3.4. Skills & knowledge

Mary Anning, Alfred Leeds and Steve Etches all accumulated considerable knowledge and skills in relation to their fossil collecting and the strata from which they were derived. Each knew intimately the hard parts of the animals they collected and in the case of Alfred Leeds, he knew in detail every bone from every position because of constant handling and the frequent 3-D preservation of the Oxford Clay fossils (Leeds, 1956). All three collectors are highly regarded and considered vastly knowledgeable about the palaeontology of their collections, so much so that they have regularly been consulted by academics and researchers. All this knowledge had been acquired through hard graft, developed by handling specimens at every stage of processing fossils, and all without the benefit of formal scientific training or academic qualifications.

Mary Anning was regularly consulted by numerous scientists and others who visited her to collect fossils, or to discuss anatomy and classification. Her knowledge was acquired through reading, hard work and presumably talking around the subject with the learned men who visited her. To better understand the fossils she collected, she dissected modern animals such as fish, cuttlefish and sea hares in order to appreciate their internal anatomy (Taylor and Torrens, 1986; Tickell, 1999). This led directly to her recognition that fossil belemnites possessed ink sacs, just like modern squid-like cephalopods, some of which had been fossilized (Buckland, 1829c). Anning was thereby able to discuss fossil organisms with professors and other learned men on an equal footing, and she probably had a more profound understanding of the marine Jurassic than anyone alive at the time. Mary and the Anning family were also astute enough to recognise the value of the fossils they found, and targeted wealthy gentlemen collectors and academics (e.g. Price, 1986), thereby maximising their business opportunities.

Alfred Leeds excelled at the careful collection of fossils, including recovering and reuniting even tiny fragments. He would spend hours washing the specimens to remove the tenacious Oxford Clay, to reveal the bones in all their beauty and detail. As Alfred handled his 'bones' at every stage of cleaning, repairing and mounting, he became intimately familiar with every bone shape and texture, which aided considerably in the re-joining of shattered or mixed skeletal elements. This allowed him to develop an intimate knowledge of the animals with which he worked (Leeds, 1956). Leeds was extremely adept at reuniting broken fragments, which were skilfully and neatly joined. These long hours of handling his specimens, together with his careful and accurate observation, allowed Alfred Leeds to become intimately familiar with both the similarities and differences between specimens. Hence, he was able to spot pathologies, evidence of predation, stomach contents, and became aware of age related, and suspected sexual variations within the most common animals he collected, such as in the skeletons of *Cryptoclidus* (Leeds, 1956).

Steve Etches has developed considerable skills in locating fossils, cleaning and preparing specimens from their rock matrix, curating his collection, as well as displaying and presenting his specimens to visitors of all types. These skills have been learned 'on-the-job' through trial-and-error and by contact with other

Please cite this article in press as: L.F. Noè, et al., Mary Anning, Alfred Nicholson Leeds and Steve Etches. Comparing the three most important UK 'amateur' fossil collectors and their collections, Proc. Geol. Assoc. (2018), https://doi.org/10.1016/j.pgeola.2018.09.001

collectors, museum professionals and academics. Steve's ability to recognise the geological horizons, and ammonite zonation within the Kimmeridge Clay of Dorset, stemmed initially from the published literature (e.g. Cope, 1978; Cox and Gallois, 1981). However, continual, systematic searching, with repeated visits to the same outcrops, has allowed Steve to develop an unrivalled local knowledge of the coastline and its outcrops (Gallois and Etches, 2001, 2010). Steve has the trained eye of the experienced collector, giving him the almost magical ability to spot a fossil from the smallest trace or hint on a surface or within a bedding plane. His willingness to collect every fossil, not just the large and spectacular finds, has made him intimately familiar with Kimmeridgian marine ecosystems (Etches and Clarke, 2010).

3.5. Personal & scientific interactions

Mary Anning, Alfred Nicholson Leeds and Steve Etches were not isolated private individuals. All three relied heavily on a network of family, friends, colleagues, and scientific contacts during their collecting careers. However, the driving force generally came from the collector, with others co-opted into the time-consuming tasks of searching for, recovering, cleaning and/or reuniting specimens. In addition, a professional network consisting of, amongst others, wealthy purchasers, quarry owners and workers, academics and the scientifically literate, was cultivated by each collector.

3.5.1. Personal interactions

Mary Anning relied on her family to support and help with fossil hunting activities. Initially Mary's father taught her to find fossils. After her father's death, Mary and her brother continued collecting fossils, whereas Molly seems to have been responsible for running the business rather than actual fossil collecting (Torrens, 1995). Mary Anning also made friends and had business transactions with various local geologists and collectors, such as Lt. Col. Birch who was a keen early customer, Elizabeth Phillpot (1780–1857) and the Phillpot sisters, and Anna Maria Pinney (ca. 1835-1860). As the fame of the Anning's increased, geologists, academics, fossil collectors and the curious came to Lyme Regis, to visit the fossil depot, buy specimens, to be guided along the coast, or simply to see Mary (Roberts, 1834).

The Leeds Collections started with Charles Leeds. Alfred Leeds became involved, probably at the behest of Charles, and the two brothers began collecting together. Whilst Charles maintained an interest in the collection, his University studies, and work in various parts of the country precluded him from day-to-day interaction with the collection after about 1868 (Leeds, 1956). However, Alfred, committed to running the Eyebury farm, managed to find sufficient time and commitment to continue developing the collection. In 1875, Alfred married Mary Ferrier Nicholson (1858–1922) of Glasgow (Liston, 2006), who became Alfred's constant companion and workmate. Mary provided endless assistance and encouragement to Alfred in his collecting endeavours, and together they washed Alfred's 'bones' and pieced together the fossil remains. As noted by E.T. Leeds, Mrs Leeds share in the development of the collections is probably much underappreciated (Leeds, 1956, p. 12). Alfred and Mary had five sons, most of whom were co-opted into their father's passion whilst young - perhaps by the age of six or seven years. However, most of Alfred's sons came to hate their father's hobby, with only the 4th born, Edward Thurlow Leeds, taking any real interest later in life. However, despite this, it is noteworthy that towards the end of Alfred's life it was Lewis Leeds who answered the calls from the Whittlesea pits, and collected two ichthyosaurs in 1917, the last recorded acquisitions to the Leeds Collections. Hence Alfred Leeds was supported by his brother Charles, later by his wife, and ultimately by his sons, but especially by E.T. Leeds (Leeds, 1956).

Whilst young, Steve Etches collecting was encouraged by his father and an English teacher at school, and he was later re-introduced to fossils and fossil collecting by his wife Sue and a local fossil shop owner. Steve, Like Mary Anning and Alfred Leeds, has roped various relations and friends into his collecting activities, including his brothers-in-law and nephew. When younger, Steve's children enjoyed fossil hunting, but later moved on to other pursuits. In addition to his family, Steve has developed a wide range of interactions with fellow collectors, including Adrian Brockenshire (affectionately referred to as Adrian 'Broken-Jaw'), David Costain, Pete Langham senior, Terry Manning, Chris and Alex Moore, and many others.

3.5.2. Scientific interactions

Mary Anning developed wide-ranging scientific interactions with numerous academics that came to discuss fossils and go fossil collecting with her. Possibly one of the most influential was her teenage friend Henry de la Beche (1796–1855) who went on to become President of the Geological Society and first Director of the British Geological Survey (Norman, 1999). Mary also had significant interactions with scientists including William Buckland (1784–1856) of Oxford University, Adam Sedgwick (1785–1873) of Cambridge University, Roderick Impey Murchison (1792–1871) and his wife Charlotte (1788–1869) who became a firm friends, Gideon Mantell (1790–1852) who visited in 1829, Charles Lyell (1797–1875) with whom she corresponded, George William Featherstonhaugh (1780–1866), Louis Agassiz (1807–1873) who visited in 1834, and Richard Owen (1804–1892) (Torrens, 1995; Tickell, 1999; McGowan, 2001). If one event cemented the reputation of the Anning family as trustworthy collectors of fossils, it was the unfounded questions raised by Baron Georges Cuvier (1769–1832) about the veracity of the first plesiosaur skeleton (Torrens, 1995). The reliability of the specimen was subsequently confirmed by a special meeting of the Geological Society in London, and this 'defeat' of Cuvier considerably enhanced the reputation of the Anning's as fossil collectors and preparators (Torrens, 1995).

The Leeds Collections were initiated through Charles Leeds scientific interactions with John Phillips in Oxford University. All of the Leeds brothers' early scientific interactions seem to have stemmed from Charles, with visits and specimens cited in the publications of Harry Seeley, James Carter (1813–1895), or found within the collection of John Francis Walker (1839–1907). However, it was not until Alfred Leeds, possibly with, or at the instigation of Charles, attended the NHMUK in London around 1885 (Leeds, 1956) to identify certain bones that the collection began to acquire the recognition it rightly deserved. Following this first London appointment, there were visits in ensuing years to Eyebury by Henry Woodward, John Whitaker Hulke (1830–1895), Arthur Smith Woodward (1864–1944), Richard Lydekker (1849–1915), Othniel Charles Marsh (1831–1899) and Charles William Andrews (1866–1924), amongst others (Leeds, 1956). These scientific interactions gave Alfred Leeds a great deal of pleasure, and many of these men of science (and their wives) became firm friends, regularly visited Eyebury and/or published on specimens in the Leeds Collections (e.g. Smith Woodward, 1888).

Steve Etches, like Mary Anning and Alfred Leeds, has always been extremely open to visits from the scientific community who wish to examine his collection. In order to understand more about his fossils and their geological setting, Steve attended John Cope's courses on Dorset Geology at Bristol University, and Paul Ensom's geology courses at Dorset County Museum (DCM) (Etches and Clarke, 2010). Steve has often visited the DCM and the NHMUK to seek references and to compare specimens. In addition, Steve has been in contact with a wide range of academics including Beverly Halstead (1933–1991) and his then ph.D. student David Unwin

Please cite this article in press as: L.F. Noè, et al., Mary Anning, Alfred Nicholson Leeds and Steve Etches. Comparing the three most important UK 'amateur' fossil collectors and their collections, Proc. Geol. Assoc. (2018), https://doi.org/10.1016/j.pgeola.2018.09.001

(University of Leicester), Ramues Gallios (The British Geological Survey, Keyworth), Phil Powell (The Oxford University Museum of Natural History, Oxford), Dave Martill (University of Portsmouth), Dino Frey (Staatliches Museum für Naturkunde Karlsruhe), Arthur Cruickshank (1933–2011), Mike Benton (University of Bristol) and his students, as well as the lead author, amongst others.

Steve has had both good and bad experiences with members of the academic community: very positive encouragement from Bev Halstead, Arthur Cruickshank, Dave Martill and others, but less good experiences where his collection has not been acknowledged, or the promised reprints have never appeared. On one occasion, a specimen lent to an academic left the country without Steve's knowledge, and only later was it discovered that a paper had been published describing the specimen as a holotype of a new species (Fleck and Nel, 2003), without Steve's knowledge. As a result, specimens were no longer available for loan, but needed to be studied within the collection (Etches and Clarke, 2010). Today, with the collection residing in the MJML, specimens subject to the loan policies of the museum.

3.6. Recognition and acknowledgement

Fossil collectors, rather like museum preparators and conservators, are often overlooked or under-acknowledged when specimens are published. Also, typically, collectors are not recognised early in their careers, however, as a collection and its importance grows, naturally greater recognition follows. There are five ways in which the work undertaken by a collector can be recognised: acknowledgement in printed works published by others; a specimen being named after the collector; the collector publishing on their collection; through membership of scientific bodies, their awards and obituaries; and through the publication of images illustrating the collector or their works.

3.6.1. Acknowledgement in print

Publishing is seen as an academic pursuit, and the 'gold standard' of science, especially when peer-reviewed. Collectors thereby usually rely on others to publish their specimens and collections. However, this means the collector is at the mercy of the academic in terms of acknowledgement of his or her work. An alternative route through which publication of a collectors' work can occur is in the popular press or books, where reporters and authors typically desire human interest stories, thereby framing the collector at the centre of the story. There is also a cultural element, where if collectors are of lower social status or are paid for their specimens they are often under acknowledged (Taylor and Torrens, 1986; Torrens, 1995), whereas the person paying for a specimen, and to whose collection it is added, is often explicitly named, producing a considerable imbalance. In addition, a collector who acquires specimens for their own interest (a kind of personal gain) or for 'the good of science' are often viewed as somehow 'more noble', and the collector will often be recorded as the source of the specimen(s). Social status is also important, as wealthy collectors (such as Alfred Leeds) are more likely to be integrated into scientific societies, with their associated costs in terms of membership, and the time and money needed to attend meetings.

The Annings had variable fortune with the publications of others recognising Mary or the Anning family as the source of published specimens. The first Anning specimen to cause a major sensation was an ichthyosaur (now *Temnodontosaurus platyodon*, NHMUK R1158) jointly discovered by Joseph and Mary in 1811-12. It was sold by the Annings to Henry Hoste Henley (1766–1833) of Sandringham, and later passed to the museum of William Bullock ($_c$1773-1849) in Piccadilly, London (Torrens, 1995). Whilst in Bullocks museum, this specimen, and later others, were described and interpretation attempted in a series of papers (Home, 1814, 1816, 1818, 1819a, 1819b), however, at no time was the collectors name (if known) acknowledged in print, although the purchaser and possible owner of the land from which it was recovered, Henry Host [sic] Henley was mentioned by name. In addition, the preparation work believed to have been undertaken by the Annings (Torrens, 1995), was attributed to staff at Bullocks museum (Home, 1814). The same occurred with the first complete specimen and holotype of *Plesiosaurus* (NHMUK 22,656), which was discovered by Anning in December 1823 (Torrens, 1995). It was described with great fanfare (Conybeare, 1824), but at no time was it mentioned that the specimen had been collected by the Annings. However, the Anning's discovery of preserved ink sacs of belemnites, the recognition of 'bezoar stones' as coprolites, and the discovery of the first pterosaur outside Germany were all acknowledged as her work (Buckland, 1829a,b,c). On the other hand, when a very fine plesiosaur discovered by Mary in 1830 and sold for 200 guineas (210 GBP) was described, Anning was not named as the collector (Owen, 1840). However, when Thomas Hawkins excavated an ichthyosaur at Lyme in the 1830s, he did attribute Mary Anning as the discoverer (Hawkins, 1834).

Mary Anning was recognised during her lifetime in various books, popular or semi-scientific publications, and in poetry (Bowles, 1828; Cumberland, 1829, 1830; Roberts, 1834; Kenyon, 1838; Murchison, 1839; Goodrich, 1840); Anning's discoveries were also noted in various popular journals and newspapers (e.g. Anonymous, 1823a; b; Anonymous, 1829). This helped cement the importance of both Mary and Lyme Regis as a place to visit as source of important fossils (e.g. Carus, 1846). Various accounts or notices of Mary Anning also appeared in the years following her death (e.g. Anonymous, 1857, 1865; Mantell, 1851; Zornlin, 1852).

During the lifetimes of Charles and Alfred Leeds, the Leeds Collections were principally published on by Phillips, Seeley, Hulke, Lydekker, Smith Woodward and Andrews (Woodward et al., 1904). The earliest published Leeds Collections specimens were belemnites (Phillips, 1865) and a pliosaurid jaw and paddle (Phillips, 1871). There was then an extended period before Seeley visited Eyebury in 1874 (Leeds, 1956). Seeley published three papers, including two new genera, on the plesiosaurian *Muraenosaurus* Seeley, 1874 (see also Seeley, 1874a) and the ichthyosaur *Ophthalmosaurus* Seeley, 1874. Following a much longer gap, when Charles probably had little to do with the collection, a crustacean claw was noted from the Leeds Collection (Carter, 1886). Following a visit to the NHMUK around 1885 (Leeds, 1956), probably instigated by Charles prior to his immigration to New Zealand, members of staff at the National Museum became fully aware of the quality of the Leeds Collection, and publications rapidly followed. This commenced with the dinosaurs *Ornithopsis* and *Omosaurus*, both erroneously ascribed to the Kimmeridge Clay (Hulke, 1887), followed by sauropterygians (e.g. , Lydekker, 1888; Andrews, 1897; 1909a), crocodilians (e.g. Hulke, 1888; Andrews, 1909b; Lydekker, 1890), fish (e.g. Smith Woodward, 1888, 1889b, 1892, 1896), and other dinosaurs (Lydekker, 1889, 1893; Smith Woodward, 1905).

Publications on the Leeds Collection initially focused on the description of new species, however with time, these increasingly concentrated on the detailed description of poorly known parts of the skeleton (e.g. Hulke, 1892; Andrews, 1911; Seeley, 1892, 1893), on interpretation of variation within and between previously known genera (Smith Woodward, 1893; Andrews, 1895c; 1896, 1907; Seeley, 1908a, b, or on the wider osteological implications, ecological interactions, growth series, stomach contents and possible sexual dimorphism between specimens (e.g. Andrews, 1895a,b,d; Baur, 1889). Following sales of specimens to Stürtz, Leeds specimens were published on within mainland Europe (Jaccard, 1908b, a), but especially in Germany (e.g. Jaekel, 1904; von

Please cite this article in press as: L.F. Noè, et al., Mary Anning, Alfred Nicholson Leeds and Steve Etches. Comparing the three most important UK 'amateur' fossil collectors and their collections, Proc. Geol. Assoc. (2018), https://doi.org/10.1016/j.pgeola.2018.09.001

Arthaber, 1906; Abel, 1907; Koken and Linder, 1913; Linder, 1913). These sometimes resulted in the naming of new species (e.g. Schmidt, 1904; Smellie, 1915, 1916), which Alfred Leeds considered unwarranted. There were also exchanges between the NHMUK and American Museum of Natural History (Williston, 1906). The Leeds name began to appear in an increasing number of catalogues of fossils organisms and museum guides (e.g. Smith Woodward and Sherbourn, 1890; Woodward, 1896, 1904). However, probably the ultimate acknowledgement of the importance of the Leeds Collections in print was the publication of the two volume 'Catalogue', specifically on the Leeds Collections (Andrews, 1910a, 1913). These detailed the ichthyosaur *Ophthalmosaurus* and the plesiosaurs *Muraenosaurus*, *Picrocleidus*, *Tricleidus* and *Cryptocleidus* [*sic*] in volume 1 (Andrews, 1910a), and the pliosaurids *Pliosaurus*, *Simolestes*, *Peloneustes* and the crocodilians *Steneosaurus*, *Mycterosuchus* and *Metriorhynchus* in volume 2 (Andrews, 1913). These two books remain lasting testaments to Alfred Leeds lifetime work.

In all these publications, Alfred Leeds, his brother Charles, or both, were acknowledged as the source of the specimens. It was only very occasionally Leeds Collections specimens were published without explicit acknowledgement (e.g. Andrews, 1896). However, this acknowledgement was probably due to the relatively high social status of the Leeds family, and their personal contacts with high-ranking museum officials, rather than any particular change in the culture of academic publishing since the time of Mary Anning. Clearly the fact specimens were sold cannot be the reason for lack of attribution to Anning, as Leeds continued to be acknowledged as the source of specimens long after the sale of the First Leeds Collection in 1890–1893 (Woodward et al., 1904).

As a recent collection, relatively few of the Etches specimens have as yet been published. Exceptions include: referral of a large pliosaurid mandible (MJML K1) to *Pliosaurus portentificus* Noè et al., 2004, although this name is currently considered a *nomen dubium* (Knutsen, 2012); description of the ammonites *Subdichotomoceras lamplughi dorsetense* (MJML K1715), *Tolvericeras anglicum* (MJML K312) and *Pseudogravesia* sp. indet. (MJML K1581, K1757) (Énay et al., 2014); tooth and postcranial material (MJML K181, K434) referred to *Plesiosuchus manselii* (Young et al., 2012); and description of a Rhamphorhynchin pterosaur jaw (MJML K1235) (Martill, 2014a). This lack of reference to Etches specimens to some extent stems from reluctance on the part of academics and editors to publish on specimens held in a private collection; it was certainly not due to a lack of access to the collection. However, as researchers and scientific publishing houses recognise the Etches Collection is now a registered museum, it is likely a wave of new taxa will be published (Martill, 2014b), and this work has now begun.

3.6.2. Naming specimens after the collector

Another form of recognition of the work of a collector is to name a species, or occasionally genera, after the discoverer. During Mary Anning's lifetime, only two species were named after her, the fish *Acrodus anningae* (Agassiz, 1833-1845aAgassiz, 1833aAgassiz, 1833-1845a, b) and *Belenostomus anningiae* (Agassiz, 1833-1845). Subsequent to her death, and especially recently as Mary Anning's story has become more widely known, it has become fashionable to name new species after her, including the scleractinian coral *Tricycloseris anningi* (Tomes, 1878), the therapsid *Anningia* (Broom, 1927), the bivalve genus *Anningella* (Cox, 1958), an ostracod *Cytherelloidea anningi* (Lord, 1974), the plesiosaur *Anningasaura lymense* (Vincent and Benson, 2012) and the ichthyosaur *Ichthyosaurus anningae* (Lomax and Massare, 2015), irrespective of whether the specimens were collected by the Annings or not.

Alfred Leeds had various species, and one genus, named after him during his lifetime. The first was the plesiosaur *Muraenosaurus leedsii* Seeley, 1874, the only sauropterygian named after him. This was followed by the dinosaurs *Ornithopsis leedsi* Hulke, 1887 *Camposaurus leedsi* Lydekker, 1889, *Sarcolestes leedsi* Lydekker, 1893, *Omosaurus leedsi* (Seeley in von Huene, 1901: 718) and *Cetiosaurus leedsi* Smith Woodward, 1905 (for current status see Noè and Liston, 2010). Of the crocodilians, a single species, *Steneosaurus leedsi* Andrews 1909 was named after Alfred Leeds. However, a larger number of fish bear the Leeds name, including the species: *Hypsocormus leedsi* Smith Woodward, 1889a; b; *Pachymylus leedsi* Smith Woodward, 1892; *Mestursus leedsi* (Smith Woodward, 1895); *Lepidotes leedsi* (Smith Woodward, 1895); *Osteorachis leedsi* (Smith Woodward, 1897); and the genus *Leedsichthys problematicus* Smith Woodward, 1889a; b (see also Smith Woodward, 1889a, 1890). The large number of species named after Alfred Leeds during his lifetime is a direct indication of the importance the Leeds Collections, and Leeds high social status.

A relatively recent presumption against naming taxa after private individuals, and that the Etches Collection, although available for study, was until recently in private hands, has probably reduced the rate of publication on numerous important specimens. To date, six taxa have been named after Steve Etches: the ichnotaxon *Astacimorphichnus etchesi* Wignall, 1991 (although the holotype does not lie within the Etches Collection); an aeschnidiid dragonfly (MJML K619) *Kimmeridgebrachypteraeschnidium etchesi* Fleck and Nell, 2003; a cirripede (MJML K1261) *Etchestepus durotrigensis* Gale, 2014a (see also Gale, 2014b, 2018 this issue); a pterosaur (MJML K1597) *Rhamphorhynchus etchesi* O'Sullivan and Martill, 2015; a batoid ray (MJML K874, K 1894) *Kimmerobatis etchesi* Underwood and Claeson, 2018 this issue; and a muensterellid coleoid cephalopod (MJML K1802) *Etchesia martilli* Fuchs, 2018 this issue. With the Etches Collection now in a permanent public repository the rate of publications has steadily increased, and we keenly await many more.

3.6.3. Self-publication

Generally, collectors are not the scientific interpreters of their specimens or collections. Hence, it is relatively rare for collectors to also be authors. The work of a collector takes considerable, and often underappreciated, time - time that is not available to publish high-quality scientific works. This means the number of publications authored by our three collectors is strictly limited. So far as is known, Mary Anning only produced a single published article (Anning, 1839), in the form of an extract from a letter in response to a misconception about *Hybodus* (Charlesworth, 1839).

For Alfred Leeds, although he had an intimate understanding of the fossils he so patiently collected, cleaned and re-united, he was not a 'man of letters' and therefore did not commit his knowledge to paper (Harker, 1918; Leeds, 1956). Leeds always considered himself a collector, and therefore left the scientific interpretation to others, which means much of his accumulated knowledge and experience can be found (often acknowledged) under the names of others (e.g. Andrews, 1910a, 1913). However, Alfred Leeds co-led, with Arthur Smith Woodward, a Geologists' Association field excursion to the Peterborough brick pits the write up of which he co-authored (Leeds and Smith Woodward, 1897). In another instance, Alfred left the correction of an error in the interpretation of the hind-leg of a metriorhynchid crocodile (von Arthaber, 1906), sold through Stürtz, to his son Edward Thurlow Leeds (Leeds, 1907).

Steve Etches intimate knowledge of the Kimmeridge Clay Formation successions has proven invaluable, and he has co-authored several published articles on Dorset Kimmeridge Clay stratigraphy (Gallois and Etches, 2001, 2010; Grange et al., 1996). Steve has also published a number of jointly authored papers on the fossils in his collection, including on predation (Clarke and Etches, 1991; Etches and Clarke, 1993), the Kimmeridge Clay

Please cite this article in press as: L.F. Noè, et al., Mary Anning, Alfred Nicholson Leeds and Steve Etches. Comparing the three most important UK 'amateur' fossil collectors and their collections, Proc. Geol. Assoc. (2018), https://doi.org/10.1016/j.pgeola.2018.09.001

ammonite fauna (Énay et al., 2014; Gallois and Etches, 2010), ammonite eggs (Etches et al., 2009), and jointly described the monofenestratan pterosaur *Cuspicephalus scarfi* Martill and Etches, 2013 (see also Witton et al., 2015) and the metriorhynchid crocodylian *Torvoneustes coryphaeus* Young et al., 2013. Steve has also published a multipart catalogue of his collection (Etches and Clarke, 1999-2003; Etches and Clarke, 1999) and a book describing his collecting activities and collection (Etches and Clarke, 2010).

3.6.4. Membership, fellowship, awards and obituaries of scientific societies

Mary Anning, as a working-class, working woman, and member of the rural poor, was not eligible, nor presumably able to afford, the subscription to join the Geological Society of London, where many of her finds were first scientifically announced (e.g. Conybeare, 1824; Buckland, 1829a; Egerton, 1837). Much has been written about the gender and social status of Mary Anning. During the lifetime of Mary Anning, most scientists were financially independent Anglican gentlemen (often supported behind-the-scenes by wives and daughters). Anning, however, was of low social status compared to her scientific contemporaries, and hence was unable to participate fully in the 19th century scientific community. However, her contribution was recognised in other ways, usually by individual members of the established scientific or social elite. For instance in 1820, the Anning family were in considerable financial hardship. This led Lt. Col. Birch to sell his collection of fossils (a number originally purchased from the Annings) at auction at Bullocks in London. This act of charity netted around 400 GBP, and was used to support the Anning family (Torrens, 1995), although how much of the money was passed to the Annings is not known. However, the Birch auction brought wealthy fossil buyers from far and wide, and the Anning name became well-known across Britain, Europe and North America as a source of spectacular fossils (Carus, 1846). Subsequently the Annings were known, visited by, conversed with, and corresponded with, a wide range of scientific, wealthy and literary figures. In 1838, 200 GBP was raised by members of the British Association for the Advancement of Science, and a further 300 GBP given by the UK government, to provide an annuity ('pension') of 25 GBP per annum (Torrens, 1995), which provided Mary some level of financial security. Finally, in 1846, once already ill with breast cancer, another subscription was raised by members of the Geological Society of London, and in July Mary was elected the first Honorary Member of the Dorset County Museum (Torrens, 1995).

Following Mary's death in 1847, Henry de la Beche summarized her life in his Presidential address to the Geological Society of London, later published in the QJGS, the Society's journal (De la Beche, 1848). Although not an obituary notice in the sense of those provided for Fellows of the Society, it was a landmark event, as the first death of a scientific woman noted in the Society's Journal (Tickell, 1999). Subsequently members of the Geological Society, led by Henry de la Beche, raised funds towards the construction of a stained glass window in Mary Anning's memory above her grave in the church of St. Michael the Archangel in Lyme Regis (Torrens, 1995).

Alfred Leeds, in contrast to Mary Anning, was a relatively wealthy gentleman farmer. Leeds was therefore eligible, and could afford, to become a Fellow of the Geological Society of London. In 1893, Leeds palaeontological work was recognised by an award of half of the Geological Society's Lyell Fund (Anonymous, 1893). After his death, Alfred Leeds obituary appeared in Geological Magazine (Smith Woodward, 1917) and the Quarterly Journal of the Geological Society (Harker, 1918).

Steve Etches contributions to palaeontology have been recognised by several awards and prizes. Steve has received the Palaeontological Association's Award to Amateur Palaeontologists (1993), The Geological Society of London R.H. Worth Prize (1994), the Palaeontological Association Mary Anning Award (2005), the Geologists' Association Halstead Medal (2006) and an honorary Doctor of Science by the University of Southampton (2017). However, Steve's crowning glory to date is the award, in 2014, of an MBE by the Queen at Windsor Castle for services to Palaeontology. We keenly await his knighthood.

Fig. 7. *Duria Antiquior*, or 'A More Ancient Dorset', a copy of the original 1830 pen, ink and watercolour wash sketch by Henry de la Beche, a lithographic version of which was engraved by Schaff and sold in aid of the Anning family. The organisms are based on those found at Lyme Regis, many of which were discovered, excavated, prepared and sold by Mary Anning and her family. Image courtesy and copyright the National Museum of Wales.

Please cite this article in press as: L.F. Noè, et al., Mary Anning, Alfred Nicholson Leeds and Steve Etches. Comparing the three most important UK 'amateur' fossil collectors and their collections, Proc. Geol. Assoc. (2018), https://doi.org/10.1016/j.pgeola.2018.09.001

3.6.5. Acknowledgement in images

Likenesses and pictorial representations of palaeontologists have long been an important method of recognition and outreach (for instance see the 'Eminent Living Geologists' series formerly published in Geological Magazine). For Mary Anning, several likenesses are known. A watercolour sketch undertaken by Henry de la Beche in the 1830s shows Anning prospecting the Lyme Regis-Charmouth shoreline dressed in unflattering, but practical field attire (reproduced in McGowan, 2001; Pierce, 2006). An 1842 painting of Anning resides in the NHMUK, London by an unknown artist, but possibly William Gray (c1818-1883), shows Anning on the seashore holding a collecting bag and hammer, pointing to an ammonite which is being protected by her faithful dog Tray. This portrait, which may have been painted for exhibition at the Royal Academy but was rejected, passed to Joseph Anning, and was presented to the NHMUK by Mary's great-great niece Annette Anning (1876–1938) in 1935. A copy of the painting was made by the artist Benjamin John Merifield Donne (1831–1928), in 1850, shortly after Anning's death, and now resides in the Geological Society of London (Fig. 1A). Donne went to school in Lyme Regis and knew, or knew of, Mary as a boy, and may have visited Joseph Anning to copy the painting. More recently a photograph purporting to show Mary Anning observing a rock face pointed to by a gentleman, has surfaced, but this image is unlikely to depict Mary Anning (Taylor and Levitt, 2015).

Henry de la Beche was inspired to sketch *Duria Antiquior* ('A More Ancient Dorsetshire') in 1830, based on fossil discoveries around Lyme Regis, and which drew heavily on specimens collected by Mary Anning (Fig. 7). De la Beche had the sketch lithographed by Georg Scharf and sold prints to his scientific friends and colleagues at two pound ten shillings each to financially support the Anning family; however, it is not known how much money was raised, or how much was passed to the Anning family. The prints of *Duria Antiquior* thereby became the first widely circulated scientific reconstruction of a fossil ecosystem (Witton et al., 2014), and incorporated the slightly risqué (and undoubtedly amusing) act of organisms producing proto-coprolites (Duffin, 2009).

The best known image of Alfred Leeds is a painting by his young cousin, the artist William Nicholson (later knighted), showing Alfred Leeds perched working on his bones in his attic 'bone room' (Fig. 3C). Following Alfred Leeds death in 1917, an obituary featured in Geological Magazine, with a published portrait (Smith Woodward, 1917). In addition, a number of photographs of Alfred Leeds survive with the Leeds family, including one with his wife, another in his bone room, and one with his wife and family (Fig. 3A). No specific images reconstructing the Oxford Clay based on the Leeds fauna are known to exist or to have been published.

With the advent of modern photography, almost every private individual has numerous photographs available (Fig. 5). However, as a tribute to the life and work of Steve Etches, and to record the opening of the Museum of Jurassic Marine Life in Kimmeridge, the first author has commissioned (with the financial assistance of Universidad de los Andes, Bogotá) a new reconstruction of the Kimmeridgian fossil fauna, in the style of De la Beche's *Duria Antiquior*. This drawing shows the fauna and flora of the Kimmeridge Clay Formation, as enlightened by the Etches Collection. This work, entitled *Kimmeridgia Antiquior* ('A More Ancient Kimmeridge'), is presented here as a tribute and lasting testament to Steve Etches and his life's work (Fig. 8). The original has been donated to the Museum of Jurassic Marine Life by Bob Nicholls, the artist, to accompany the fossil collection that inspired the artwork. We hope this will remain, together with the Etches collection, a lasting testament to Steve Etches life's work.

3.7. Scientific impact

Mary Anning, Alfred Leeds and Steve Etches have all had, and are likely to continue to have, a profound impact on the science of palaeontology. This is most clearly enumerated in the range and

Fig. 8. *Kimmeridgia Antiquior*, or 'A More Ancient Kimmeridge', a reconstruction of Kimmeridgian seas illustrating some of the specimens contained in the Etches Collection, drawn in the style of *Duria Antiquior* by Henry de la Beche (Fig. 7). This newly commissioned artwork is by Robert Nicholls (Palaeocreations), from on an original idea by LFN. Image copyright MJML, Universidad de los Andes, Leslie Noè and Robert Nicholls.

Please cite this article in press as: L.F. Noè, et al., Mary Anning, Alfred Nicholson Leeds and Steve Etches. Comparing the three most important UK 'amateur' fossil collectors and their collections, Proc. Geol. Assoc. (2018), https://doi.org/10.1016/j.pgeola.2018.09.001

number of new taxa each collected. However, the impact of each collector is much more subtle and profound than the simple accountancy-like counting of the number of taxa collected and named. The effect of their work is much more wide ranging and insightful, in terms of changes in the way in which we view ourselves in relation to the Earth's history.

The Anning specimens had a profound influence on the new sciences of geology and palaeontology. In 1811 Mary's brother Joseph discovered the head of an ichthyosaur, *Temnodontosaurus platyodon* (NHMUK R1158), which caused a sensation when displayed a Bullock's Museum, so much so it was acquired by the NHMUK. In the winter of 1820–1821 Mary discovered the first described specimen of *Plesiosaurus* (De la Beche and Conybeare, 1821) and in 1823 excavated the first complete skeleton, soon after named as *Plesiosaurus dolichodeirus* (Conybeare, 1824) the type specimen of the genus, and the nomotypical genus of Plesiosauria. This specimen caused a sensation in scientific circles in London, and raised questions as to its authenticity by Cuvier in Paris, generating a debate in the Geological Society of London in early 1824 (Torrens, 1995). As a result, Anning was proven to have correctly and legitimately provided science with a completely new animal, which considerably enhancing her credentials as a trustworthy collector and seller of fossils in the eyes of the scientific and general public.

In December 1828 Mary discovered the first British pterosaur *Dimorphodon macronyx* (Buckland, 1829a), and in 1828 and 1829 the fish *Dapedium* (Anonymous, 1829) and *Squaloraja* (Riley, 1837; Taylor and Torrens, 1986), at the time the latter considered an intermediate between sharks and rays. In 1829 Mary discovered an extremely well-preserved plesiosaur, now *Plesiosaurus macrocephalus* Owen (1840). In addition Mary was instrumental in recognising 'bezoar stones' as coprolites (Buckland, 1829c), and belemnites as squid-like organisms which used ink sacs for defence as in modern cephalopods (Buckland, 1829b). The range of new or newly recognised organisms, and the new scientific interpretations in which Mary Anning was involved, is therefore phenomenal. This work considerably changed scientific thinking, led to the clear recognition of fossils as living things, and that the past was considerably different to today. Mary Anning's fossil finds were therby important in opening up new views on old worlds and showed how living things in the past were similar to, and could therefore be compared to, living things today. However, Anning's fossils also showed that the past was very different to the present, provided additional evidence for the reality of extinction and in some ways paved the way for the acceptance of the Theory of Evolution (Darwin, 1859).

Alfred Leeds discoveries contributed considerably to the scientific understanding of Jurassic marine ecosystems (Martill et al., 1994). New genera and species recovered by Alfred Leeds included the long-necked plesiosaur *Muraenosaurus* (Seeley, 1874b), the ichthyosaur *Ophthalmosaurus* (Seeley, 1874c), the giant fish *Leedsichthys problematicus* (Smith Woodward, 1889b), the dinosaurs *Sacrolestes leedsi* (Lydekker, 1893) and *Callovosaurus leedsi* (Lydekker, 1889) (see Noè and Liston, 2010), and the pliosaurid *Simolestes vorax* Andrews, 1909. In addition, Leeds specimens included the first articulated paddles of the plesiosaur *Cryptocleidus* and the ichthyosaur *Ophthalmosaurus*, and rare soft-part preservation such as the tracheal rings of *Steneosaurus* (Andrews, 1913). A growth series of *Cryptoclidus oxoniensis*, clearly showed variation depended not only on species specific differences, but also on age and possibly sexual dimorphism (Andrews, 1895b, 1896,1910a). Leeds Collections fish included specimens with preserved cartilage, and provided proof the selachian genus *Asteracanthus* had the teeth previously attributed to *Strophodus* (Smith Woodward, 1888).

Perhaps one of the most important aspects of the Leeds Collections was that much of the fauna was preserved in three-dimensions (Woodward, 1896). Lyme Regis (and other localities, such as Street in Somerset, and Holzmaden in Germany) had produced fine examples of slab mounted ichthyosaurs, plesiosaurs and crocodiles (Hawkins, 1834, 1840; Urlichs et al., 1986), however, Leeds specimens were recovered from the relatively soft Oxford Clay, which allowed every bone to be examined from all directions (Woodward et al., 1904). This permitted a more holistic understanding of the animals and a fuller appreciation of the Middle Jurassic ecosystem preserved in the Oxford Clay. For the first time skeletons of ichthyosaurs (Andrews, 1915), plesiosaurs (Andrews, 1895a, 1910b) and crocodiles could be mounted in 3-D, similar to the skeletons of the modern organisms (Woodward, 1896), and greatly inspired the public imagination (Fig. 4A, B).

The Etches collection includes numerous new species, as well as examples of exceptional preservation. Many fish and sharks represent new species or unique specimens in the UK, with perhaps a dozen or more undescribed species: the Etches Collection thereby comprises the greatest variety of Kimmeridgian pterosaur and fish remains in the UK. Additional important fossils include uncrushed bones and specimens that have 'nose-dived' into soft soupy sediments (Martill, 1993), predation marks on bones and shells, wear facets on teeth, stomach contents of vertebrates, coprolites that show interactions between species (including cephalopod hooklets, bone fragments and fish jaws), cephalopods with soft-part preservation (Hart et al., 2018 this issue) and rare dinosaurs. Steve's continual exploration of every horizon has allowed him to understand entire Kimmeridge ecosystems, although, only time and new research will reveal the full scientific importance of the Etches Collection.

3.8. Amateur or Professional?

Ultimately, we consider whether Mary Anning, Alfred Leeds and Steve Etches should be considered as amateurs or professionals. Mary Anning's collecting can be considered her profession, as fossils were always a source of income for her and the Anning family. On the other hand, Mary's considerable contributions to our understanding of palaeontology remained self-taught, and firmly in the realm of the amateur. Alfred Leeds almost certainly began his collecting career for his own interest, and was hence an amateur collector. However, commencing with the sale of the First Collection, fossils became an increasingly important part of maintaining the family in the style to which they were accustomed. Hence with time, Alfred Leeds morphed from an amateur into a commercial (and hence professional) collector. However, in terms of palaeontology, Alfred Leeds remained a lifelong amateur scientist. Steve Etches is an amateur fossil collector through-and-through. He collects fossils purely for his own interest, and has never sold specimens. This thereby sets Steve apart from our other collectors, and classifies him as both an amateur collector and palaeontologist.

4. Conclusions

Mary Anning, Alfred Leeds and Steve Etches all were (or are) remarkable private individuals. All three dedicated their lives to the discovery, recovery, preparation and display of the exceptional Jurassic fossils found close to where they lived. The commitment, skill, effort and knowledge of these three private individuals is at least on a par with academic palaeontologists, and yet their outputs are typically less recognised, yet much more tangible and long lasting. However, it is likely the work of Mary Anning, Alfred Leeds and Steve Etches, and many more collectors not considered here, will stand the test of time better than much of the published

Please cite this article in press as: L.F. Noè, et al., Mary Anning, Alfred Nicholson Leeds and Steve Etches. Comparing the three most important UK 'amateur' fossil collectors and their collections, Proc. Geol. Assoc. (2018), https://doi.org/10.1016/j.pgeola.2018.09.001

academic literature. It is therefore abundantly clear amateur collectors have a major role to play in the science of palaeontology (Torrens, 2006).

Mary Anning, despite her poverty, low social status and non-Anglican upbringing, became one of the most influential women in British (and possibly global) palaeontology. Numerous books and journal articles have been, and continue to be, written about her, her family and the specimens she collected. Mary Anning made her name in a scientific community dominated by wealthy Anglican gentlemen of independent means, but became a household name despite the whole world apparently being stacked against her. Through hard-work and a huge will to succeed, combined with personality and lucky circumstance, Mary and her family developed a substantial support network of friends and colleagues, and managed to overcome apparently insurmountable social obstacles. Although this success was as a result of hard work and perseverance, during Mary's lifetime this was often underappreciated and on occasions attributed to the external force of 'divine favour' (Lady Harriet Silvester quoted in McGowan, 2001: 19).

In contrast to Mary Anning, Alfred Leeds was in the enviable position of being a gentleman farmer and was therefore, compared to the majority of the population, relatively affluent. However, by circumstance he was required to undertake a professional career in farming which was neither of his choice, nor particularly to his liking. However, Leeds managed to use his social status to his advantage and, as with Mary Anning, through lucky circumstance of place and time, together with personal application over long hours and for many years, was able to develop a collection of unrivalled national and international importance. Steve Etches, a plumber by trade, has always been interested in searching for and collecting objects from the natural world, and as a child was fascinated by rocks and fossils. He too, through lucky circumstance of place and time, and through sheer selfless hard work, has been able to develop an unrivalled, internationally important fossil collection. Hence we can see through unbendable personality, application in the face of hardship, perseverance where others would have given in, and the will to continue day after day, week after week, year after year was central to their successes.

The specimens collected by Mary Anning, Alfred Nicholson Leeds and Steve Etches all helped to open up new vistas on the Jurassic world. The collections amassed by all three are both scientifically and culturally important, and are likely to have an ongoing impact on the science of palaeontology and the public understanding of science. This legacy of scientific impact, cultural significance, and importance to the public view of palaeontology and science more generally is unrivalled and likely to continue long into the future. We can only hope that selfless private individuals will continue to collect fossils that can enter the public domain and continue the work of Mary Anning, Alfred Leeds and Steve Etches.

Returning to the question of whether Mary Anning, Alfred Leeds and Steve Etches were amateurs or professions, we note that all three were committed to their chosen vocation of fossil collecting, spent the majority of their lives developing their collections, and each had an unrivalled knowledge of their specialist area. All three, in relation to the times in which they lived, developed an entirely professional outlook on their fossil collecting activities, and leave a long lasting legacy to the world of palaeontology. Hence, although none of our three protagonists had, for instance, formal university educations, they developed 'cabinets of curiosities' of unrivalled importance to the science of palaeontology. Hence, all three should be considered professional collectors and palaeontologists of the highest calibre. One thing is abundantly clear: without such dedicated individuals, the lives of many 'professional' academics, museum curators, and non-academic museum visitors would be much poorer.

Acknowledgements

This contribution is based on a long-standing idea sparked by two scientific meetings held at Street, Somerset in 2009 and 2010, and we extend our thanks to numerous delegates for valuable discussions. We also thank Steve Etches (MJML) for proof reading the sections on his life and work, and for various information and corrections (however, the authors take full responsibility for any inaccuracies). We further acknowledge and thank Steve Etches and Carla Crook (MJML) for providing, and permitting publication of, the images of Steve Etches and specimens from the Etches Collection. We extend our grateful thanks to Julian Leeds and the Leeds Family for permission to republish the privately held images of Alfred Leeds and his family, amply aided by Jeff Liston (Yunnan University, China) who we also thank for his support and assistance. Our thanks go to Sandra Chapman and Lorna Steel (NHMUK), Philipe Havlik (Paläontologische Sammlung, Fachbereich Geowissenschaften, Eberhard Karls Universität Tübingen, Germany) for access to specimens, and to the Geological Society of London (and especially Caroline Lam) for assistance and permission to reproduce the portrait of Mary Anning. We thank and acknowledge the National Museum of Wales, Cardiff for permission to publish *Duria Antiquior*, and Cindy Howells for providing a digital version. Funding for LFN was provided by a 'Fondo de Apoyo para Profesores Asistentes' grant (FAPA no. P12-160422.006/01) and the manuscript completed during the tenure of a project entitled "The Paja Formation largestätte of the Alto Ricaurte: access, palaeoenvironment and taphonomy" and a Semestre de Trabajo Académico Independiente (STAI) awarded by Universidad de los Andes. MG-P was funded by a Postdoctoral Research Fellowship awarded by the Facultad de Ciencias, Universidad de los Andes. Finally, we gratefully acknowledge Malcolm Hart for his patience and editorial support during the development of this manuscript, and thank two anonymous reviewers for their valuable comments, which greatly improved an earlier version of this manuscript.

References

Abel, O., 1907. Der Anpassungstypus von Metriorhynchus. Centralblatt für Mineralogie, Geologie und Paläontologie 8, 225–235.
Agassiz, L., 1833-1845a. Recherches sur les Poissons Fossiles. Petitpierre, Neuchatel, Suisse.
Agassiz, L., 1833-1845b. Recherches sur les Poissons Fossiles. Petitpierre, Neuchatel, Suisse.
Agassiz, L., 1833-1845c. Recherches sur les Poissons Fossiles. Petitpierre, Neuchatel, Suisse.
Anderson, S.W., Damasio, H., Damasio, A.R., 2005. A neural basis for collecting behaviour in humans. Brain 128, 201–212.
Andrews, C.W., 1896. Note on the pelvis of *Cryptocleidus oxoniensis* (Phillips). Geological Magazine 33, 145–148.
Andrews, C.W., 1897. On the structure of the skull of a pliosaur. Quarterly Journal of the Geological Society of London 53, 177–185 pl. 112.
Andrews, C.W., 1907. Notes on the osteology of *Ophthalmosaurus icenicus*, Seeley, and ichthyosaurian reptile from the Oxford Clay of Peterborough. Geological Magazine 44, 202–208.
Andrews, C.W., 1911. On the structure of the roof of the skull and of the mandible of *Peloneustes*, with some remarks on the plesiosaurian mandible generally. Geological Magazine 48, 160–164.
Andrews, C.W., 1913. A descriptive catalogue of the marine reptiles of the Oxford Clay - based on the Leeds Collection in the British Museum (Natural History), London, part II. British Museum (Natural History), London.
Andrews, C.W., 1915. Note on a mounted skeleton of *Ophthalmosaurus icenicus* Seeley. Geological Magazine 52, 145–146 pl. 145.
Andrews, S.M., 1982. The discovery of fossil fishes in Scotland up to 1845 with checklists of Agassiz's figured specimens. Royal Scottish Museum, Edinburgh.
Andrews, C.W., 1895a. Note on the skeleton of a young plesiosaur from the Oxford Clay of Peterborough. Geological Magazine 32, 241–243 pl. 249.
Andrews, C.W., 1909a. On some new Plesiosauria from the Oxford Clay of Peterborough. Annals and Magazine of Natural History series 8 (4), 418–429.
Andrews, C.W., 1910a. A descriptive catalogue of the marine reptiles of the Oxford Clay - based on the Leeds Collection in the British Museum (Natural History), London, part I. British Museum (Natural History), London.

Please cite this article in press as: L.F. Noè, et al., Mary Anning, Alfred Nicholson Leeds and Steve Etches. Comparing the three most important UK 'amateur' fossil collectors and their collections, Proc. Geol. Assoc. (2018), https://doi.org/10.1016/j.pgeola.2018.09.001

Andrews, C.W., 1895b. On the development of the shoulder-girdle of a plesiosaur (*Cryptoclidus oxoniensis*, Phillips, sp.) from the Oxford Clay. Annals and Magazine of Natural History 6, 333–346.
Andrews, C.W., 1909b. On some new *Steneosaurus* from the Oxford Clay of Peterborough. Annals and Magazine of Natural History 8, 299–308.
Andrews, C.W., 1910b. Note on a mounted skeleton of a small pliosaur, *Peloneustes philarchus* Seeley, sp. Geological Magazine 47, 110–112 pl. 112.
Andrews, C.W., 1895c. On the structure of the skull in *Peloneustes philarchus*, a pliosaur from the Oxford Clay. Annals and Magazine of Natural History 16, 242–256 pl. 213.
Andrews, C.W., 1895d. The pectoral and pelvic girdles of Muraenosaurus plicatus. Annals and Magazine of Natural History 6, 429–434.
Anning, M., 1839. Extract of a letter from Miss Anning. Magazine of Natural History 3, 605.
Anonymous, 1813. A guide to all the watering and sea-bathing places for 1813. Longman, Hurst, Rees, Orme, and Brown, London.
Anonymous, 1829. Dorsetshire. The New Monthly Magazine and Literary Journal part iii. Historical Register. , pp. 43.
Anonymous, 1857. The fossil-finder of Lyme-Regis. Chambers's Journal of Popular Literature Science and Arts 8, 382–384.
Anonymous, 1865. Mary Anning, the fossil finder. All the Year Round 8, 60–63.
Anonymous, 1893. Mr. Leeds,- (awarded Lyell Geological Fund). Quarterly Journal of the Geological Society of London 49, 43–44.
Anonymous, 1912. Charles Edward Leeds, M.A., Exeter College, Oxford. Geological Magazine 49, 287.
Anonymous, 1923. A fossil reptile's egg unearthed in England. The Sphere, London p. 196.
Anonymous, 1823a. Fossil remains near Bridport. The Gentleman's Magazine and Historical Chronicle 94, 269.
Anonymous, 1823b. Lyme, Sept. 15. The Gentleman's Magazine and Historical Chronicle, vol 94. , pp. 269.
Baur, G., 1889. On the morphology of the vertebrate skull. Journal of Morphology 3, 467–474.
Belk, R.W., 1994. Collectors and collecting. In: Pearce, S.M. (Ed.), Interpreting Objects and Collections. Routledge, London and New York, pp. 317–326.
Boase, C.W., 1879. Register of the Rectors and Fellows, Scholars, Exhibitioners and Bible Clerks of Exeter College Oxford with illustrative documents and a history of the College. Rector and Fellows of Exeter College, Oxford.
Bowles, L., 1828. Days Departed; or, Banwell Hill: a lay of the Severn Sea. Cruttwell, London and Bath, Murray.
Broderip, W.J., 1837. Description of some fossil Crustacea and Radiata, found at Lyme Regis, in Dorsetshire. Transactions of the Geological Society of London 5, 171–174.
Broom, R., 1927. On a new type of mammal-like reptile from the South African Karroo beds (*Anningia megalops*). Journal of Zoology 97, 227–232.
Buckland, W., 1829a. On the discovery of a new species of pterodactyle in the Lias at Lyme Regis. Transactions of the Geological Society of London 3, 217–222.
Buckland, W., 1829b. On the discovery of a new species of Pterodactyle; and also of the fæces of the Ichthyosaurus; and of a black substance resembling sepia, or Indian ink, in the Lias of Lyme Regis. Proceedings of the Geological Society of London 1, 96–98.
Buckland, W., 1829c. On the discovery of coprolites, or fossil fæces, in the Lias at Lyme Regis, and in other formations. Transactions of the Geological Society of London 3, 223–236.
C.L.F, 1956. The Leeds Collection of fossil reptiles - review. Geological Magazine 93, 440 [Forbes, C.L.].
Carter, J., 1886. On the decapod crustaceans of the Oxford Clay. Quarterly Journal of the Geological Society of London 42, 542–559.
Carus, C.G., 1846. The King of Saxony's journey through England and Scotland in the year 1844. Chapman and Hall, London.
Chalmers-Hunt, J.M., 1976. Natural History Auctions 1700-1972, a register of sales in the British Isles. Sotherby Park Bernet Publications Ltd, London.
Charlesworth, E., 1839. On the fossil remains of a species of *Hybodus*, from Lyme Regis. Magazine of Natural History 3, 242–248.
Clarke, J., Etches, S., 1991. Predation amongst Jurassic marine reptiles. Proceedings of the Dorset Natural History and Archaeological Society 113, 202–205.
Cohen, K.M., Finney, S.C., Gibbard, P.L., Fan, J.-X., 2013. The ICS International Chronostratigraphic Chart. Episodes 36. updated 2018-08. , pp. 199–204.
Collier, L.J., 1966. Development and location of the clay-brickmaking industry in the south-east midlands of England. London School of Economics and Political Science, London.
Conybeare, W.D., 1824. On the discovery of an almost perfect skeleton of the Plesiosaurus. Transactions of the Geological Society of London 2, 381–389 pls 348-349.
Cope, J.C.W., 1978. The ammonite faunas and stratigraphy of the upper part of the Upper Kimmeridge Clay of Dorset. Palaeontology 21, 45–56.
Coulmas, F., 1989. What writing is all about, The writing systems of The world. Basil Blackwell, London, pp. 1–16.
Cox, L.R., 1958. *Anningella* nom. nov. for *Anningia* Cox non Broom. Proceedings of the Geological Society of London 1557, 44.
Cox, B.M., Gallois, R.W., 1981. The stratigraphy of the Kimmeridge Clay of the Dorset type area and its correlation with some other Kimmeridgian sequences. Institute of Geological Sciences.
Cumberland, G., 1829. Some account of the order in which the fossil saurians were discovered. Quarterly Journal of Science, Literature, and Art 345–349 April-June.
Darwin, C., 1859. On the origin of species by means of natural selection, or the preservation of favoured races in the struggle for life. John Murray, London.
De la Beche, H.T., 1848. Anniversary address of the President. Quarterly Journal of the Geological Society of London 4 xxi-cxx.
De la Beche, H.T., Conybeare, W.D., 1821. Notice of the discovery of a new fossil animal, forming a link between the *Ichthyosaurus* and crocodile, together with general remarks on the osteology of the *Ichthyosaurs*. Transactions of the Geological Society of London 5, 559–594.
Duffin, C.J., 2009. Records of warfare . . . embalmed in the everlasting hills": a history of early coprolite research. Mercian Geologist 17, 101–111.
Egerton, P.G., 1837. On certain peculiarities in the cervical vertebrae of the Ichthyosaurus, hitherto unnoticed. Proceedings of the Geological Society of London, series 2 5, 187–193 pl. XIV.
Énay, R., Gallois, R., Etches, S., 2014. Origin of the Kimmeridgian-Tithonian boreal perisphinctid faunas: migration and descendants of the Tethyan genera *Crussoliceras* and *Garnierisphinctes*. Revue de Paléobiologie, Genève 33, 299–377.
Etches, S.M., Clarke, J.B., 1993. Feeding habits of *Caturus* and new evidence of coleoid distributions from the Kimmeridge Clay of Dorset. Proceedings of the Dorset Natural History and Archaeological Society, , pp. 115.
Etches, S., Clarke, J., 1999. Steve Etches Kimmeridge Collection Illustrated Catalogue. 1999-2003. Chandler's Ford, Jane Clarke, Hampshire.
Etches, S., Clarke, J., 2010. Life in Jurassic Seas. The autobiography of a fossil collector. Ashfield Books, Chandler's Ford.
Etches, S., Clarke, J., Callomon, J., 2009. Ammonite eggs and ammonitellae from the Kimmeridge Clay Formation (Upper Jurassic) of Dorset, England. Lethaia 42, 204–217.
Fitton, W.H., 1836. Observations on some of the strata between the Chalk and Oxford Oolite, in the South-east of England. Transactions of the Geological Society of London 4, 103–388.
Fleck, G., Nel, A., 2003. Revision of the Mesozoic family Aeschnidiidae (Odonata: Anisoptera). Zoologica 154, 1–172.
Fuchs, D., 2018. A new peculiar muensterellid coleoid (Cephalopoda) from the Kimmeridge Clay Formation of Dorset (England). this issue. Proceedings of the Geologists' Association .
Gale, A.S., 2018. Stalked barnacles (Cirripedia, Thoracica) from the Upper Jurassic (Tithonian) Kimmeridge Clay of Dorset; palaeoecology and bearing on the evolution of living forms. this issue. Proceedings of the Geologists' Association .
Gale, A.S., 2014a. New cirripedes (Crustacea, Thoracica) from the Jurassic and Cretaceous of the United Kingdom. Proceedings of the Geologists' Association 125, 406–418.
Gale, A.S., 2014b. Origin and phylogeny of verrucomorph barnacles (Crustacea, Cirripedia, Thoracica). Journal of Systematic Palaeontology 13, 753–789.
Gallois, R., Etches, S., 2001. The stratigraphy of the youngest part of the Kimmeridge Clay Formation (Upper Jurassic) of the Dorset type area. Proceedings of the Geologists' Association 112, 169–182.
Gallois, R.W., Etches, S.M., 2010. The distribution of the ammonite *Gravesia* (Salfeld, 1913) in the Kimmeridge Clay Formation (Late Jurassic) in Britain. Geoscience in South-West England 12, 204–249.
Goodrich, S.G., 1840. Peter Parley's Wonders of the Earth, sea, and sky. S. Colman, New York.
Grange, D.R., Storrs, G.W., Carpenter, S., Etches, S., 1996. An important marine vertebrate-bearing locality from the Lower Kimmeridge Clay (Upper Jurassic) of Westbury, Wiltshire. Proceedings of the Geologists' Association 107, 107–116.
Grant, J., 1827. A memoir of Miss Frances August Bell, who died in Kentish Town, On Monday, the 23d of May, 1825, aged Fifteen Years and Six Months: with specimens of her compositions, in prose and verse. Hatchard & Son, London.
Harker, A., 1918. Alfred Nicholson Leeds. Quarterly Journal of the Geological Society of London 74, lxi.
Hart, M.B., Hughes, Z., Page, K.N., Price, G.D., Smart, C.W., 2018. Arm hooks of coleoid cephalopods from the Jurassic succession of the Wessex Basin, Southern England. this issue. Proceedings of the Geologists' Association .
Hawkins, T., 1834. Memoirs of Ichthyosauri and Plesiosauri, extinct monsters of the ancient earth. Relfe and Fletcher, London.
Hawkins, T., 1840. Book of the great sea-dragons, Ichthyosauri and Plesiosauri, gedolim taninim, of Moses. Extinct monsters of the ancient earth. William Pickering, London.
Hillier, R., 1981. Clay that burns, a history of the Fletton brick industry. London Brick Company Limited, London.
Home, E., 1814. Some account of the fossil remains of an animal more nearly allied to fishes than any of the other classes of animals. Philosophical Transactions of the Royal Society of London 104, 571–577.
Home, E., 1816. Some farther account of the fossil remains of an animal, of which a description was given to the Society in 1814. Philosophical Transactions of the Royal Society of London 106, 318–321.
Home, E., 1818. Additional facts respecting the fossil remains of an animal, on the subject of which two papers have been printed in the Philosophical Transactions, showing that the bones of the sternum resemble those of the Ornithorhynchus Paradoxus. Philosophical Transactions of the Royal Society of London 108, 24–32.
Home, E., 1819a. An account of the fossil skeleton of the Proteo-Saurus. Philosophical Transactions of the Royal Society of London 109, 209–211.
Home, E., 1819b. Reasons for giving the name Proteo-Saurus to the fossil skeleton which has been described. Philosophical Transactions of the Royal Society of London 109, 212–216.

Please cite this article in press as: L.F. Noè, et al., Mary Anning, Alfred Nicholson Leeds and Steve Etches. Comparing the three most important UK 'amateur' fossil collectors and their collections, Proc. Geol. Assoc. (2018), https://doi.org/10.1016/j.pgeola.2018.09.001

Hulke, J.W., 1870. Note on some plesiosaurian remains, obtained by J.C. Mansel Esq., F.G.S., in Kimmeridge Bay, Dorset. Quarterly Journal of the Geological Society of London 26, 611–622 pl. 641, figs 611-616.
Hulke, J.W., 1872. Note on some ichthyosaurian remains from Kimmeridge Bay. Dorset. Quarterly Journal of the Geological Society of London 28, 34–35 pl. 32.
Hulke, J.W., 1887. Note on some dinosaurian remains in the collection of A. Leeds, Esq., of Eyebury, Northamptonshire. Quarterly Journal of the Geological Society of London 43, 695–702.
Hulke, J.W., 1888. Contribution to the skeletal anatomy of the Mesosuchia based on fossil remains from the clays near Peterborough in the collection of A. Leeds, Esq. Proceedings of the Scientific Meetings of the Zoological Society of London 56, 417–442.
Hulke, J.W., 1892. On the shoulder girdle in Ichthyosauria and Sauropterygia. Proceedings of the Royal Society of London 52, 233–255.
Hulke, J.W., 1869a. Note on a large saurian humerus from the Kimmeridge Clay of the Dorset coast. Quarterly Journal of the Geological Society of London 25, 386–389 pl. 316.
Hulke, J.W., 1871a. Note on a fragment of a teleosaurian snout from Kimmeridge Bay, Dorset. Quarterly Journal of the Geological Society of London 27, 442–443.
Hulke, J.W., 1869b. Note on some fossil remains of a gavial-like saurian from Kimmeridge Bay, establishing its identity with Cuvier's' deuxième gavial d'Honfleur' and with Quenstedt's *Dakosaurus*. Geological Magazine 6, 367.
Hulke, J.W., 1871b. Note on an *Ichthyosaurus* (*I. enthekiodon*) from Kimmeridge Bay, Dorset. Quarterly Journal of the Geological Society of London 27, 440–443 pl. 417.
Hunt, E.H., Pam, S.J., 2002. Responding to agricultural depression, 1873-96: managerial success, entrepreneurial failure? Agricultural History Review 50, 225–252.
Jaccard, F., 1908a. Note sur le *Peloneustes philarchus* (Seeley) du musee paleontologique de Lausanne. Bulletin des laboratoires de geologie, geographie physique mineralogie et paleontologie de l'Universite de Lausanne (Suisse) 10, 1–4 pls 1-7.
Jaccard, F., 1908b. Note sur le *Peloneustes philarchus* (Seeley) du musee paleontologique de Lausanne. Bulletin de la Société Vaudoise des Sciences Naturelles 43, 395–398 pls 326-332.
Jaekel, O., 1904. Über die Bildung der ersten Halswirbel und die Wirbelbildung im allgemeinen. Zeitschrift de Deutchen geologischen Gesellschaft: Protokolle 56, 109–119.
Johnson, H.H., Barwell, F.T., 1956. The Whitworth Register. c. 1956. The Whitworth Society, London, pp. 1–235.
Kenyon, J., 1838. Poems: for the most part occasional. Edward Moxon, London.
Knutsen, E.M., 2012. A taxonomic revision of the genus *Pliosaurus* (Owen, 1841a) Owen, 1841b. Norwegian Journal of Geology 92, 259–276.
Koken, E., Linder, H., 1913. Osteologische notizen über Muraenosaurus. Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen, Jena 1, 101–115 pl. 110..
Leeds, E.T., 1907. Notes on Metriorhynchus superciliosus. Desl. Geological Magazine 44, 314–319.
Leeds, E.T., 1956. The Leeds collection of fossil reptiles from the Oxford Clay of Peterborough. BM(NH) and Basil Blackwell, Oxford.
Leeds, A.N., Smith Woodward, A., 1897. Excursion to Peterborough. Proceedings of the Geologists' Association 15, 188–193.
Leigh Star, S., Griesemer, J.R., 1989. Institutional ecology,' translations' and boundary objects: amateurs and professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39. Social Studies of Science 19, 387–420.
Linder, H., 1913. Beiträge zur Kenntnis der Plesiosaurier-gattungen *Peloneustes* und *Pliosaurus*. In: Koken, E. (Ed.), Geologische und Paläontologishe Abhandlungen. Gustav Fischer, Jena, pp. 339–407 pls 331-334.
Lindert, P.H., 1982. Revising England's social tables 1688-1812. Explorations in Economic History 19, 385–408.
Liston, J., 2006. From Glasgow to the Star Pit and Stuttgart: a short journey around the world's longest fish. Glasgow Naturalist 24, 59–71.
Liston, J.J., Chapman, S.D., 2014. Alfred Nicholson Leeds and the first fossil egg attributed to a' saurian'. Historical Biology 26, 229–235.
Liston, J.J., Noè, L.F., 2004. The tail of the Jurassic fish *Leedsichthys problematicus* (Osteichthyes: Actinopterygii) collected by Alfred Nicholson Leeds - an example of the importance of historical records in palaeontology. Archives of Natural History 30, 236–252.
Lomax, D., Massare, J.A., 2015. A new species of *Ichthyosaurus* from the Lower Jurassic of West Dorset, England, U.K. Journal of Vertebrate Paleontology 35 e903260.
Lord, A., 1974. Ostracods from the Domerian and Toarcian of England. Palaeontology 17, 599–622.
Lord, A.R., Davis, P.G., 2010. Fossils from the Lower Lias of the Dorset Coast. In: Lane, P.D. (Ed.), Field Guides to Fossils. Palaeontological Association, London p. viii + 436.
Lydekker, R., 1888. Notes on the Sauropterygia of the Oxford and Kimmeridge Clays, mainly based on the collection of Mr Leeds at Eyebury. Geological Magazine 25, 350–356.
Lydekker, R., 1889. On the remains and affinities of five genera of Mesozoic reptiles. Quarterly Journal of the Geological Society of London 45, 41–59 pl. 42.
Lydekker, R., 1890. On a crocodilian jaw from the Oxford Clay of Peterborough. Quarterly Journal of the Geological Society of London 46, 284–288.
Lydekker, R., 1893. On the jaw of a new carnivorous dinosaur from the Oxford Clay of Peterborough. Quarterly Journal of the Geological Society of London 49, 284–287.
Mansel-Pleydell, J.C., 1873. A brief memoir on the geology of Dorset, part I. Geological Magazine 10, 402–413.
Mansel-Pleydell, J.C., 1888. Fossil reptiles of Dorset. Proceedings of the Dorset Natural History and Antiquities Field Club 9, 1–40.
Mantell, G.A., 1851. Petrifactions and their teaching; or, a hand-book to the gallery of organic remains of The British Museum. Henry G. Bohn, London.
Martill, D.M., 1993. Soupy substrates: a medium for the exceptional preservation of ichthyosaurs of the Posidonia Shale (Lower Jurassic) of Germany. Kaupia - Darmstaedter Beiträgezur Naturgeschichte 2, 77–97.
Martill, D.M., 2014a. A functional odontoid in the dentary of the Early Cretaceous pterosaur *Istiodactylus latidens*: implications for feeding. Cretaceous Research 47, 56–65.
Martill, D.M., 2014b. The Steve Etches collection of Kimmeridge clay fossils: a Jurassic jewel on the Jurassic Coast. Proceedings of the Dorset Natural History & Archaeological Society 135, 160–164.
Martill, D.M., Etches, S., 2013. A new monofenestratan pterosaur from the Kimmeridge Clay Formation (Kimmeridgian, Upper Jurassic) of Dorset, England. Acta Palaeontologica Polonica 58, 285–294.
Martill, D.M., Hudson, J.D., 1991. Fossils of the Oxford Clay. The Palaeontological Association, London p. 286.
Martill, D.M., Taylor, M.A., Duff, K.L., 1994. The trophic structure of the biota of the Peterborough Member, Oxford Clay Formation (Jurassic), UK. Journal of the Geological Society, London 151, 173–194.
McGowan, C., 2001. The dragon seekers. Perseus Publishing, Cambridge, Massachusetts.
McNamara, K., 2012. Prehistoric fossil collectors. Geoscientist 22, 14–19.
Moody, R.T.J., Buffetaut, E., Naish, D., Martill, D.M., 2010. Dinosaurs and other extinct saurians: a historical perspective, Special Publication. Geological Society, London p. vi + 394.
Morgans-Bell, H.S., Coe, A.L., Hesselbo, S.P., Jenkyns, H.C., Weedon, G.P., Marshall, J.E. A., Tyson, R.V., Williams, C.J., 2001. Integrated stratigraphy of the Kimmeridge Clay Formation (Upper Jurassic) based on exposures and boreholes in south Dorset, UK. Geological Magazine 138, 511–539.
Murchison, R.I., 1839. The Silurian System founded on geological researches in the counties of Salop, Hereford, Radnor, Montgomery, Caermarthen, Brecon, Pembroke, Monmouth, Gloucester, Worcester, and Stafford; with descriptions of the coal-fields and overlying Formations. John Murray, London.
Neaverson, E., 1935. Reptiles from the Oxford Clay of Peterborough in the Geological Collection of the University of Liverpool. Proceedings of the Liverpool Geological Society 16, 234–262.
Newman, M., 2010. Middle Devonian fish from the Orcadian Basin of Scotland, International Palaeontological Congress. IPC, London, London p. 90.
Noè, L.F., 2009. The Alfred Leeds collection of Fossil Vertebrates; past, present and future. NatSCA News 17, 10–13.
Noè, L.F., Liston, J., 2010. 'Old bones, dry subject': the dinosaurs and pterosaur collected by Alfred Nicholson Leeds of Peterborough, England. In: Moodie, R.T.J., Buffetaut, E., Naish, D., Martill, D.M. (Eds.), Dinosaurs and other extinct saurians: a historical perspective. The Geological Society, London, pp. 49–77.
Noè, L.F., Smith, D.T.J., Walton, D.I., 2004. *Liopleurodon macromerus*. Proceedings of the Geologists' Association 115, 13–24.
Norman, D.B., 1999. Mary Anning and her times: the discovery of British palaeontology (1820-1850). Trends in Ecology and Evolution 14, 420–421.
O'Sullivan, M., Martill, D.M., 2015. *Rhamphorhynchus* (Pterosauria: Rhamphorhynchinae) in the Kimmeridge Clay of the UK. Proceedings of the Geologists' Association 126, 390–401.
Oldroyd, D., 2013. A preliminary analysis of biographies and autobiographies of geologists. Earth Sciences History 32 vii-xii.
Owen, R., 1840. A description of a specimen of the *Plesiosaurus macrocephalus*, Conybeare, in the collection of Viscount Cole, M.P., D.C.L., F.G.S., & c. Transactions of the Geological Society of London 2, 515–535 pls 543-545.
Owen, R., 1850. Description of the fossil reptiles of the chalk formation. In: Dixon, F. D. (Ed.), The Geology and Fossils of the Tertiary and Cretaceous formations of Sussex. Longman, Brown, Green, and Longmans, London, pp. 378–408 pls 337-340.
Owen, R., 1861. Monograph on the Reptilia of the Kimmeridge Clay and Portland Stone, no. I. The Palaeontographical Society, London.
Owen, R., 1863. Monograph on the Reptilia of the Kimmeridge Clay and Portland Stone, part II. The Palaeontographical Society, London.
Owen, R., 1869. Monograph on the Reptilia of the Kimmeridge Clay and Portland Stone, no III. The Palaeontographical Society, London.
Pearce, S.M., 1994. Interpreting Objects and Collections, Leicester Readers in Museum Studies. Routledge, London and New York p. xii + 343.
Perry, P.J., 1972. Where was the' great agricultural depression'? A geography of agricultural bankruptcy in late Victorian England and Wales. Agricultural History Review 20, 30–45.
Phillips, J., 1865. A monograph of British Belemnitidae. The Palaeontographical Society, London.
Phillips, J., 1871. Geology of Oxford and the valley of the Thames. Clarendon Press, Oxford.
Pierce, P., 2006. Jurassic Mary, Mary Anning and the primeval monsters. Sutton Publishing, Stroud.
Porter, H., 1861. The geology of Peterborough and its vicinity. T. Chadwell, Peterborough.
Price, D., 1986. Mary Anning specimens in the Sedgwick Museum, Cambridge. Geological Curator 4, 319–324.

Please cite this article in press as: L.F. Noè, et al., Mary Anning, Alfred Nicholson Leeds and Steve Etches. Comparing the three most important UK 'amateur' fossil collectors and their collections, Proc. Geol. Assoc. (2018), https://doi.org/10.1016/j.pgeola.2018.09.001

Ramundo, P.S., Damborenea, S.E., 2011. Interaction and circulation of symbolic goods in Quebrada de La Cueva, Jujuy, Argentina: the fossil *Weyla alata* (von Buch). Comptes Rendus Palevol 10, 679–689.
Riley, H., 1837. On the Squaloraia. Transactions of the Geological Society of London 5, 83–88.
Rixon, A.E., 1976. Fossil Animal Remains: their preparation and conservation. Athalone Press, London.
Roberts, G., 1830. A Guide Descriptive of the Beauties of Lyme Regis, being a sketch of the situation, salubrity, and picturesque scenery; with an account of the environs, and a description of the great storm, in 1824. c. 1830. Ham and Landray; Baldwin and Cradock, Lyme.
Roberts, G., 1834. History of the Antiquities of the Borough of Lyme Regis and Charmouth. Samuel Bagster and William Pickering. Landray, and Bennet & Dunster, London and Lyme Regis.
Schmidt, W.E., 1904. Über *Metriorhynchus jaekeli* nov. sp. Zeitschrift de Deutchen geologischen Gesellschaft: Protokolle 56, 97–108.
Seeley, H.G., 1892. The nature of the shoulder girdle and clavicular arch in Sauropterygia. Proceedings of the Royal Society of London 51, 119–151.
Seeley, H.G., 1893. Further observations on the shoulder girdle and clavicular arch in the Ichthyosauria and Sauropterygia. Proceedings of the Royal Society for the Advancement of Science 54, 149–168.
Seeley, H.G., 1874a. Note on some of the generic modifications of the plesiosaurian pectoral arch. Quarterly Journal of the Geological Society of London 30, 436–449.
Seeley, H.G., 1908a. On the extremity of the tail in Ichthyosauria. Annals and Magazine of Natural History 8, 436–441.
Seeley, H.G., 1874b. On *Muraenosaurus leedsii*, a plesiosaurian from the Oxford Clay, part I. Quarterly Journal of the Geological Society of London 30, 197–208 pl. 121.
Seeley, H.G., 1908b. On the interlocking of the neural arches in Ichthyosauria. Annals and Magazine of Natural History 8, 441–444.
Seeley, H.G., 1874c. On the pectoral arch and fore limb of *Ophthalmosaurus*, a new ichthyosaurian genus from the Oxford Clay. Quarterly Journal of the Geological Society of London 30, 696–707.
Simmons, J.E., 2016. Museums a history. Rowman & Littlefield, Lanham, Boulder, New York, London.
Smellie, W.R., 1915. On a new plesiosaur from the Oxford Clay. Geological Magazine 52, 341–343.
Smellie, W.R., 1916. *Apractocleidus teretipes*: a new Oxfordian plesiosaur in the Hunterian Museum, Glasgow University. Transactions of the Royal Society of Edinburgh 51, 609–629.
Smith, A.B., Batten, D.J., 2002. Fossils of the Chalk, In: Batten, D.J. (Ed.), Field Guide to Fossils. second ed. The Palaeontological Association, London p. ix + 374.
Smith Woodward, A., 1888. On some remains of the extinct selachian *Asteracanthus* from the Oxford Clay of Peterborough, preserved in the collection of Alfred N. Leeds, Esq., of Eyebury. Annals and Magazine of Natural History 2, 336–342.
Smith Woodward, A., 1890. Notes on some new and little-known British Jurassic fishes. Report of the British Association for the Advance of Science 59, 585–586.
Smith Woodward, A., 1892. On some teeth of new chimaeroid fishes from the Oxford and Kimmeridge clays of England. Annals and Magazine of Natural History 10, 13–16.
Smith Woodward, A., 1893. The cranial osteology of the Mesozoic ganoid fishes, *Lepidotus* and *Dapedius*. Proceedings of the General Meetings for Scientific Business of the Zoological Society of London 1893, , pp. 559–565.
Smith Woodward, A., 1895. Catalogue of fossil fishes in the British Museum (Natural History), part III. British Museum (Natural History), London.
Smith Woodward, A., 1896. On some remains of the pycnodont fish *Mesturus*, discovered by Alfred N. Leeds, Esq., in the Oxford Clay of Peterborough. Annals and Magazine of Natural History 17, 1–16.
Smith Woodward, A., 1897. A contribution to the osteology of the Mesozoic amioid fishes *Caturus* and *Osteorachis*. Annals and Magazine of Natural History 19 (292-297), 379–387 pls 298-211.
Smith Woodward, A., 1905. On parts of the skeleton of *Cetiosaurus leedsi*, a sauropodous dinosaur from the Oxford Clay of Peterborough. Proceedings of the Zoological Society, London 1, 232–243.
Smith Woodward, A., 1917. Obituary. Alfred Nicholson Leeds, F.G.S. Geological Magazine 54, 478–480 pl. 431.
Smith Woodward, A., 1889a. Notes on some new and little-known British Jurassic fishes. Annals and Magazine of Natural History 6, 405.
Smith Woodward, A., 1889b. Preliminary notes on some new and little-known British Jurassic fishes. Geological Magazine 26, 448–455.
Smith Woodward, A., Sherbourn, C.D., 1890. A catalogue of British fossil vertebrata. Dulau, London.
Taquet, P., 2003. Quand les reptiles marins anglais traversaient la manche. Mary Anning et Georges Cuvier, deux acteurs de la découverte et de l'étude des ichthyosaures et des plésiosaures. Annales de Paléontologie 89, 37–64.
Taylor, M., 1989. Thomas Hawkins FGS (22 July 1810 - 15 October 1889). Geological Curator 5, 112–114.
Taylor, M.A., 1997. Before the dinosaurs: the historical significance of the fossil marine reptiles. In: Callaway, J.M., Nicholls, E.L. (Eds.), Ancient Marine Reptiles. Academic Press, San Diego pp. xix-xlxv.
Taylor, M.A., 2014. Rediscovery of an *Ichthyosaurus breviceps* Owen, 1881 sold by Mary Anning (1799-1847) to the surgeon Astley Cooper (1768-1841) and figured by William Buckland (1784-1856) in his Bridgewater Treatise. Geoscience in South-West England 13, 321–327.
Taylor, M.A., Levitt, S., 2015. Mary Anning (1799-1847) and the photograph *The Geologists* ascribed to William Henry Fox Talbot (1800-1877). Geoscience in South-West England 13, 419–427.
Taylor, M.A., Torrens, H.S., 1986. Saleswoman to a new science: Mary Anning and the fossil fish *Squaloraja* from the Lias of Lyme Regis. Proceedings of the Dorset Natural History and Archaeological Society 108, 135–148.
Taylor, M.A., Torrens, H.S., 2014. An anonymous account of Mary Anning (1799-1847), fossil collector of Lyme Regis, England, published in *Chamber's Journal* in 1857, and its attribution to Frank Buckland (1826-1880), George Roberts (c. 1804-1860) and William Buckland (1784-1856). Archives of Natural History 41, 309–325.
Tickell, C., 1999. Princess of palaeontology. Nature 400, 321.
Tomes, R.F., 1878. On the stratigraphical position of the corals of the Lias of the Midland and Western counties of England and of South Wales. Quarterly Journal of the Geological Society of London 34, 179–198 pl. 179.
Torrens, H., 1995. Mary Anning (1799-1847) of Lyme;' the greatest fossilist the world ever knew'. The British Journal for the History of Science 28, 257–284.
Torrens, H.S., 1998. Life, times and legacy of Mary Anning (1799-1847) fossilist. Transactions of the Leicester Literary & Philosophical Society 92, 4–5.
Torrens, H.S., 2006. Note on' the amateur' in the development of British geology. Proceedings of the Geologists' Association 117, 1–8.
Turner, M., 1992. Output and prices in UK agriculture, 1867-1914, and the great agricultural depression reconsidered. Agricultural History Review 40, 38–51.
Underwood, C.J., Claeson, K.M., 2018. *Kimmerobatis etchesi* gen. et sp. nov. and the Jurassic radiation of the Batoidea. Proceedings of the Geologists' Association .
Urlichs, M., Wild, R., Ziegler, B., 1986. Fossilien aus Holzmaden. Staatlichen Museum für Naturkunde in Stuttgart, Stuttgart.
Vincent, P., Benson, R.B.J., 2012. *Anningasauria*, a basal plesiosaurian (Reptilia, Plesiosauria) from the Lower Jurassic of Lyme Regis, United Kingdom. Journal of Vertebrate Paleontology 32, 1049–1063.
Vincent, P., Taquet, P., 2010. A plesiosaur specimen from the Lias of Lyme Regis: the second ever discovered plesiosaur by Mary Anning. Geodiversitas 32, 377–390.
von Arthaber, G., 1906. Beiträge zur kenntnis der organisation und der Anpassungsercheinungen des genus Metriorhynchus. Beiträge zur Palaeontologie und Geologie Oesterreich-Ungarns und des Orients 19, 287–320 pls 222-237.
von Huene, F., 1901. Notizen aus dem Woodwardian-Museum in Cambridge. Centralblatt für Mineralogie, Geologie und Paläontologie. .
Wignall, P.B., 1991. Dysaerobic trace fossils and ichnofabrics in the Upper Jurassic Kimmeridge Clay of southern England. Palaios 6, 264–270.
Williston, S.W., 1906. North American plesiosaurs: *Elasmosaurus*, *Cimoliasaurus*, and *Polycotylus*. American Journal of Science 21, 221–236 pls 221-224.
Witton, M.P., Naish, D., Conway, J., 2014. State of Palaeoart. Palaeontologia Electronica 17, 1–10.
Witton, M.P., O'Sullivan, M., Martill, D.M., 2015. The relationships of *Cuspicephalus scarfi* Martill and Etches, 2013 and *Normannognathus wellnhoferi* Buffetaut et al., 1998 to other monofenestratan pterosaurs. Contributions to Zoology 84, 115–127.
Woodward, H., 1896. A guide to the fossil reptiles and fishes in the Department of Geology and Palæontology. British Museum (Natural History), London.
Woodward, H., 1904. A retrospect of palæontology in the last forty years. Geological Magazine 41, 145–157.
Woodward, H.B., 1908. The history of the Geological Society of London. Longmans, Green, and Co., London, New York, Bombay, and Calcutta.
Woodward, B.B., Murray, G., Woodward, A.S., Fletcher, L., 1904. The history of the collections contained in the Natural History Departments of the British Museum. The Trustees of the British Museum, London.
Wyse Jackson, P.N., Connolly, M., 2002. Fossils as Neolithic funereal adornments in County Kerry, south-west Ireland. Geology Today 18, 139–143.
Young, M.T., Brusatte, S.L., Brandalise de Andrade, M., Desojo, J.B., Beatty, B.L., Steel, L., Fernández, M.S., Sakamoto, M., Ruiz-Omeñaca, Schoch R.R., 2012. The cranial oseology and feeding ecology of the metriorhynchid crocodylomporph genera *Dakosaurus* and *Plesiosuchus* from the Late Jurassic of Europe. PLoS One 7, 1–42.
Young, M.T., Brandalise de Andrade, M., Etches, S., Beatty, B.L., 2013. A new metriorhynchid crocodylomoprh from the Lower Kimmeridge Clay Formation (Late Jurassic) of England, with implications for the evolution of dermatocranium ornamentation in Geosaurini. Zoological Journal of the Linnean Society 169, 820–848.
Zornlin, 1852. In: John, W. (Ed.), Recreations in geology. Third Edition Parker and son, London.

Please cite this article in press as: L.F. Noè, et al., Mary Anning, Alfred Nicholson Leeds and Steve Etches. Comparing the three most important UK 'amateur' fossil collectors and their collections, Proc. Geol. Assoc. (2018), https://doi.org/10.1016/j.pgeola.2018.09.001