REPORT

A fossilised Jurassic tree stump in Markeaton Park, Derby

The original Markeaton Hall in Derby was of late medieval date. It was owned by the Mundy family from the early sixteenth century but then demolished in 1755 and replaced, on the same site, by a more fashionable house. The surrounding land was landscaped by the garden designer William Emes (1729/30–1803). Between 1790 and 1800 an extension was built to the north and at the same time the main entrance was moved from the west to the east. The last of the Mundy owners was Emily Maria Georgiana Mundy (née Cavendish) (1845–1929). On her death the Hall passed to her cousin the Reverend William Gilchrist Clarke-Maxwell (1865–1935) who oversaw the transfer of the Hall and the surrounding grounds that now comprise Markeaton Park, to Derby Council. The Hall itself was demolished in 1964.

For more detail on the history of Markeaton Hall and Park, readers are referred to *From Mearca to Clarke-Maxwell: A History of Markeaton and Mackworth* by Don Farnsworth (1987). But, the particular focus of our interest is a fossilised Jurassic tree stump that is currently situated not far from where the Hall once stood (Fig. 1). To the best of our knowledge, this has not previously been documented.

The fossilised tree stump is not widely known and the many regular visitors to Markeaton Park are unaware of it. Although there are paths that pass close by, most people, if they notice it at all, probably take it for a nondescript stone. It is only on closer inspection that it becomes more intriguing. Whilst fossilised tree stumps are not particularly rare, this one is of interest because it is now a great distance from its point of origin, and it is the last survivor of what was once quite a large collection of fossilised stumps within the park. Hopefully, this article might serve in a small way to publicise its presence and strengthen its chances of future survival.

The fossilised tree stump

The specimen is part of a fossilised trunk of an early type of cypress or juniper tree (widely called *Protocupressinoxylon purbeckensis,* although the precise taxonomy is in some dispute). It is preserved in a sub-circular, three-dimensional form with a diameter of *c.*60 cm, height of *c.*55 cm and circumference of *c.*190 cm (Fig. 2). The outer bark is missing, allowing the internal structure of the tree rings, now replaced by silica, to be seen in a rough longitudinal section. They are closely spaced and where they are strongly curved, they probably represent part of the root system, indicating that the specimen represents only the lowest part of a tree trunk that was probably several metres tall.

Many examples of this type of fossilised conifer have been found in rocks of late Jurassic age in Dorset. They were commonly encountered during the nineteenth century when stone quarrying operations on the Isle of Portland were particularly extensive (Webster 1826), and they were first described when the famous Fossil Forest at nearby Lulworth Cove was discovered (Buckland & De La Beche 1835).

Geological context

In late Jurassic times, about 145 million years ago, Britain was located further south, at about 36° north of the equator, where the climate was warm and dry, just as in the Mediterranean area today (Francis 1983). Indeed, the island of Cyprus may take its name from

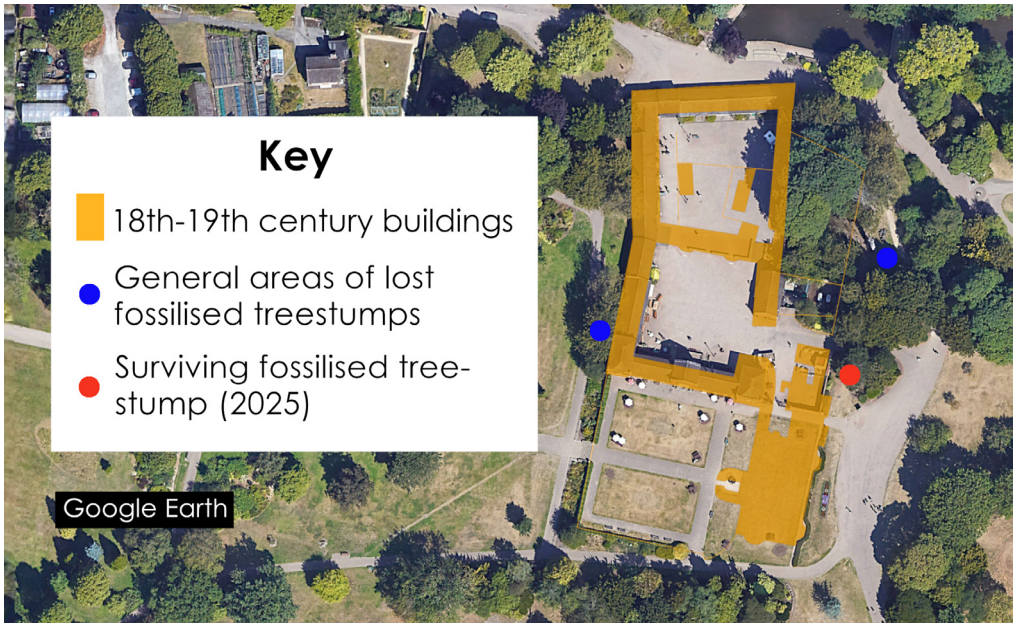

***Figure 1**. The fossilised tree stump is located approximately six metres east of the courtyard. Image courtesy of Google Maps. Overlay by Kirsten Leach of the Industrial Folkways Project.*

***Figure 2**. The near-cylindrical shape of the stump suggests that the process of silicification occurred soon after the tree was buried, providing it with a rigidity that prevented significant distortion during subsequent phases of burial.*

the widespread forests of cypress trees that used to cover the island, and the juniper forests of Oregon and California in the western USA occur in a very similar climatic setting.

The Dorset conifers grew in widespread and quite dense forests, close to lakes and lagoons that contained saline water. Periodically those water bodies expanded, flooding parts of the forest and killing off the vegetation. The dead trees were then blown over, falling into the saline water which essentially pickled and temporarily preserved the hard parts of the tree, such as the trunk (West 2018). Most of the soft leaves and twigs would have rotted away or been eaten by animals such as dinosaurs, early mammals and reptiles.

As the tree trunks were buried in saliferous sediment, and with the passage of time, chemical reactions between the groundwater and the wood led to a gradual replacement, cell-by-cell, of the organic matter (cellulose and lignin) with the mineral silica. Silica is very hard and it essentially preserves the internal structure of the tree trunk in its original form. Once the tree trunk is petrified in this way it remains entombed in the surrounding rock for many millions of years, until it is revealed by quarrying activities or natural processes of erosion.

Stumps in the park

There were three or four of these fossilised tree stumps in the immediate area in 2000 and, according to a member of the public, there were about eight or nine specimens lining either side of a slightly curved path roughly flanking the eastern courtyard wall in the early 1950s. The lone surviving stump is believed to be less than ten metres from its original location.

Another member of the public (with an interest in geology) recalls that in the early 1950s there was also a smaller collection of stumps parallel to the western courtyard wall of what is now the craft village. Both of these people remember that although the stones were of different heights they were all of the same colour and appearance. So, presumably, they all came from the same source, which is likely to be the Isle of Portland.

It is remembered that children used to try to jump from one tree stump to another, but this was not quite possible as they were too far apart. This suggests that the distance between them was about two metres. Even in the early 1950s, because of the children's jumping and climbing activities, some of the stones were becoming worn and jagged. Here may be a clue as to what happened to the majority of the fossils; they may have been removed for health and safety concerns, only for their whereabouts to then be forgotten.

Stones on the move

On the assumption that the fossils originated in Dorset, it is interesting to speculate on their passage to Derby. As far as we know the avenues of fossilised tree stumps do not appear in any written record, and in correspondence Mrs Anne Clarke-Maxwell (a current trustee of the park) assures us that when Markeaton Hall was transferred to public ownership in 1929 her ancestor, the Reverend William Gilchrist Clarke-Maxwell, did not make any additions to the park but rather focused his efforts on keeping it open for the people of Derby.

Of earlier owners of Markeaton Park the most likely candidates to have installed the fossils are William Mundy M.P. (1801–1877) and his wife (née Harriet Georgiana Frampton, 1805–1886). They can both be envisaged as taking an interest in such artefacts because William Mundy was President of the Derby Town and County Museum and Natural History Society and his wife's correspondence reveals her to have had a keen interest in botany.

Harriet Mundy was originally from Moreton in Dorset and as a girl she spent considerable time in Weymouth[1] (superscript numbers refer to Fox Talbot Correspondence 1837–72). After their marriage in 1830 the Mundys retained links to Dorset. Their son Francis Noel Mundy was born in Moreton in 1833 and the family used to regularly spend holidays in Weymouth, the gateway to the Isle of Portland – a place where to this day a large fossilised tree of the same species can be seen (in the gardens of the Portland Heights Hotel).

The local fossils may have first been pointed out to them by Mrs Mundy's cousin, the renowned geologist William Thomas Horner Fox-Strangways (1795–1865), whose family home was in Abbotsbury, a village on the coast near to Weymouth. It was probably a family servant from Moreton who was given the job of transporting the large and very heavy fossils by horse-drawn cart to Derby. Possibly some combination of cart, canal and/or rail transport was used, as Derby had a railway from as early as 1838. Whatever the methods employed, bearing in mind that there may have been more than a dozen stones, each weighing upward of 500 kg, their relocation to Markeaton would have been a very considerable undertaking.

The correspondence of the pioneer photographer Fox Talbot (Mrs Mundy's brother-in-law and another of her cousins), who married William Mundy's sister Constance in 1832, reveals the Mundys to have been in Weymouth (with Mrs Mundy's mother) from the beginning of April 1837[2] to 28 April 1837[3], and again on 7 April 1838[4], 26 February 1839[5] and 15 January 1860[6]. These are just the trips we know about, but there may have been others.

On 18 April 1837, Mrs Mundy wrote to her cousin Fox Talbot, from 13 Gloucester Row in Weymouth: 'we enjoy this place very much & the Extreme cheapness of the houses & freshness of the air rise it most Exceedingly high in my estimation – The Esplanade is so much lengthened since I was here that the privacy of one's walk is immensely encreased [sic] because nobody has strength to walk far on it & so the upper end near which we live is as quiet as possible – I even carry my own baby up & down near our house when I like, which is certainly not like an ordinary Watering place'[7]. The baby mentioned here is the Mundys' second son who sadly died later that year on 14 September. Mrs Mundy returned to holiday in Weymouth in August 1877[8], after the death of her husband earlier that year.

Other members of the Mundy family also spent time in Weymouth. The unmarried sisters of William Mundy stayed in Weymouth over the winter of 1838–39[9] and the next generation of Markeaton's owners, Francis Noel Mundy (1833–1903) and his wife Emily Maria Georgiana (née Cavendish, 1845–1929), also spent holidays in Weymouth[10]. Whilst it is possible that it was this later generation who were responsible for bringing the fossils to Markeaton, it seems more likely to have been William and Harriet Mundy, possibly under the guidance of Fox-Strangways, not least because the fashion for relocating fossilised tree stumps to parks and gardens for ornamental purposes was at its height in the 1830s and 1840s (Hugh Torrens, pers. comm.).

Conclusions

It was a curious surprise to discover a large and distinctive fossilised tree stump in Derby that was apparently collected from Dorset during the early nineteenth century and transported more than two hundred miles in order to provide an aesthetically pleasing and scientifically interesting ornament for a stately home. Within living memory, the sole surviving tree stump was part of a larger collection that once lined the garden paths close to Markeaton Hall, providing a fragile link with the Mundy family and their predilection for natural history. For at least the last two decades the fossil has been largely forgotten and ignored. However, its rediscovery has recently stirred some interest, and gratitude – that, albeit at a reduced scale, Derby's very own *Jurassic Park* still survives.

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Specific letters are identified numerically as follows:
1. Alicia Campbell to Fox Talbot, no.476; also, Elizabeth Theresa Feilding to Fox Talbot, no.797.
2. Harriet Georgiana Mundy to Fox Talbot (26 March 1837), no.3491.
3. Harriet Frampton to Fox Talbot, no.3505.
4. William Mundy to Fox Talbot, no.284.
5. Harriet Georgiana Mundy to Fox Talbot, no.3818.
6. Harriet Georgiana Mundy to Fox Talbot, no.237.
7. Harriet Georgiana Mundy to Fox Talbot, no.3505.
8. Letter from A. Fox Strangways to Mrs Mundy. Dorchester History Centre. D-1907, item 16 (loose).
9. Elisabeth Theresa Feilding to Fox Talbot (11 November 1838), no.3749.
10. Harriet Georgiana Mundy to Fox Talbot (25 February 1867), no.9199; also, Rosamund Constance Talbot to Fox Talbot (15 April 1872), no.9867.

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REPORT

Understanding the geochemical variability of flint across spatial scales from micrometers to kilometers

Chemo-stratigraphy—the use of elemental concentrations in rocks for their characterisation and correlation—has been a staple of sedimentary geologists since the 1980s and used extensively in Europe and beyond as part of oil exploration (e.g. review of Craigie 2021). The ability to 'fingerprint' these rocks across both space and time is particularly attractive for regional mapping when other diagnostic tools such as mineralogy or fossil specimens are inconclusive. The pioneering work of Clayton (1984) was the first detailed geochemistry on flint, focusing on the modes of flint formation and geological controls. Bands of flint nodules in chalk are a readily visible macroscopic feature for large scale stratigraphy. Mortimore (2020) noted that the Seven Sisters Flint Band could be followed from Yorkshire in the northeast to Devon in the southwest, and across the English Channel in the south to the Yonne region of the eastern Paris Basin, France. Flint is not only found within well-defined stratigraphic sections (primary sources) but may be found as 'clay with flints' in southern England, the likely result of dissolution of original chalk (Gallois 2009), or in secondary surficial deposits such as tills or river gravels, e.g. in the Trent valley (Henson 1985). Additionally, there are flints that have been moved by man, for example a valuable and robust cutting tool used in the East Midlands (at Creswell Crags) since the Late Middle Palaeolithic (60–40,000 b.p.). Such flints are widely found in plough soil, in particular later material from the Neolithic and Bronze ages.

Archaeologists are particularly keen to identify sources of flint to understand both the movement of people and their material culture artefacts. Simple macroscopic observations on flint colour, alteration zones or fossil remnants have been used to assign likely flint geological sources (Bradley et al 2020). As a result of the synergy of geology and archaeology, much of the work on chemo-typing flint artefacts and making use of chemo-stratigraphy to fingerprint flint has been by geo-archaeologists. This work has been predicated on the assumption that the elemental chemistry of a flint from a site is representative of that region and that different regions will have a different signature. One of the authors with others produced a database of flint chemistries from material collected as nodules from English geological locations and grouped these into eight regions. Geostatistics (canonical discriminant analysis) were then used to produce a chemical fingerprint for each region. Subsequent analysis of archaeological flints allowed them to be assigned these regional groups, with in most cases a sensible attribution (Pettitt et al 2012). A similar England-wide study by Bradley et al (2020), including geological source material from Northern Ireland, used a related methodology. They also chose to only break down their sites into the three English regional groups of Hopson (2005): Northern, Southern and Transitional, as well as a fourth from Northern Ireland.

The UK is not the only area where chemo-typing of flint has occurred: others include material from Italy (Moroni & Petrelli 2005), Demark and Sweden (Hughes et al 2012), Belgium (Fiers et al 2019), Israel (Finkel et al 2019) and the Balkans (Moreau et al 2016). All these archaeological studies have concluded that it is possible to chemo-type flints and make some intra- and intra-regional assignments, but the results are frequently not as clear-cut as might be desired.

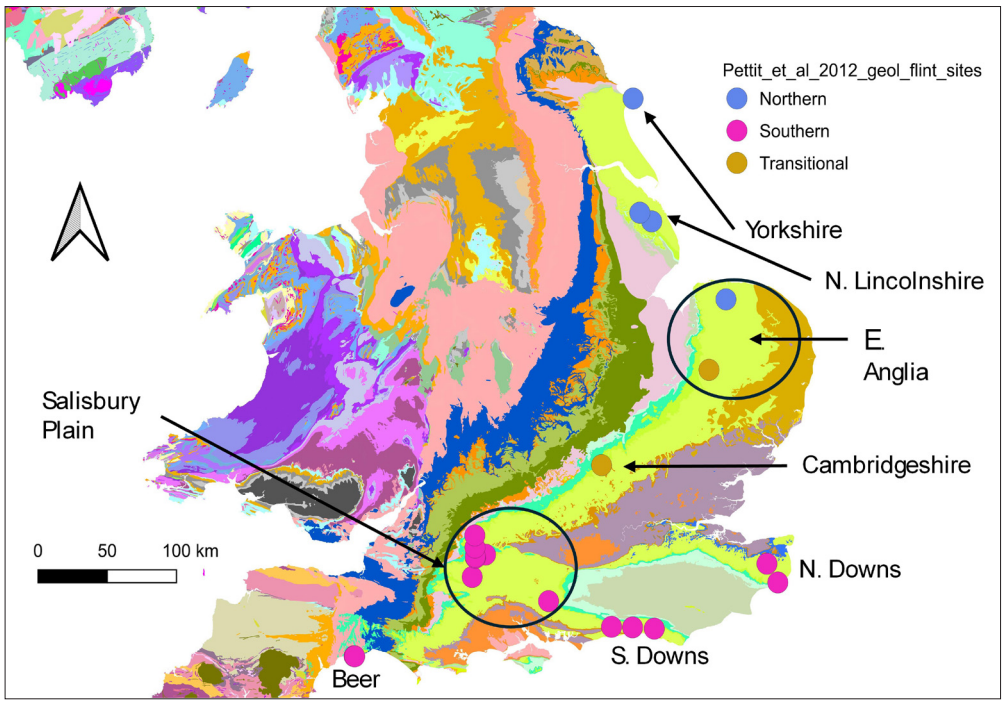

***Figure 1**. Geological flint collection sites, placed on BGS open source 625K geological base map, with site province (Northern, Southern and Transitional after Hopson, 2005) and assigned geographical region (Pettitt et al, 2012).*