

# **The Miss Phillips's Conglomerate of the Malvern Hills - Where is Phillips's original site?**

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## **ABSTRACT**

The discovery in 1842 of a Silurian beach deposit on the Malvern Hills was an important step in uncovering the geological history of the area. Knowledge of the site of this discovery has been lost for about a century but a number of possibilities have been put forward. In this paper, the documentary evidence is analysed and compared with the local geography and geology. The location of the discovery is unambiguously determined.

## **1. INTRODUCTION**

In 1842 Ann Phillips, the sister of the Survey geologist John Phillips, found fragments of a fossiliferous beach conglomerate on the Malvern Hills. This was soon followed by the discovery of the bed known now as the 'Miss Phillips's Conglomerate'. The exact location of this discovery has been a minor mystery for the last hundred or more years. This is an important site in the history of geological research in the Malvern Hills since it established the probable relationship between the igneous rocks of the hills and the Silurian sediments to the west. In particular, it appeared to demonstrate that Silurian sediments lay as a beach deposit upon what are now known to be Precambrian rocks, and therefore post-dated them. This ran counter to the prevailing view at the time, that the igneous rocks were intrusive, 'trap' rocks of a date later than the Silurian (Murchison, 1839). The true nature of the western boundary of the Precambrian rocks of the Malvern Hills has nevertheless been a topic of much controversy and varied opinions up to the present day (e.g. Oliver and Payne, 2004). The boundary has some characteristics of both an unconformity and a fault.

No one in the last hundred or more years appears to have ventured a definite opinion on the exact location of the Phillips's discovery although the literature reveals several references to possible sites. The purpose of this work is to show that evidence in John Phillips's own writings serves to eliminate all but one of the possibilities. Evidence from other sources allows the position of the site to be defined quite closely.

This paper shows many quotations from geologists of the 19<sup>th</sup> century. They used a nomenclature which is now outdated. Both old and new terminologies are used where appropriate throughout this work. Table 1 shows the nearest equivalences.

<b>Old Terminology</b>	<b>Nearest Current Terminology</b>
Wenlock limestone	Much Wenlock Limestone
Wenlock shale	Coalbrookdale Formation
Woolhope limestone	Woolhope Limestone Formation
Caradoc sandstone	May Hill Sandstone Group
Caradoc conglomerate	May Hill Sandstone Group
May Hill conglomerate	May Hill Sandstone Group
Malvernian	Malverns Complex
trap	igneous rock
Archaean	Precambrian

**Table 1.** Equivalence between old and current terminologies

## **2. PHILLIPS'S INITIAL DESCRIPTION OF THE DISCOVERY SITE**

Phillips's initial description of the discovery of the conglomerate, firstly by his sister as loose fragments and then, *in situ*, by both of them, is well known (Phillips, 1842, 1848). It is this description that appears to have been the chief basis of subsequent suggestions for the location of the discovery site. The description is, however, ambiguous in relation to the Malvern Hills.

Phillips describes the location firstly in the following words.

The abundance of detritus on all the slopes is so great as to conceal for the most part the junction of the stratified and unstratified rocks. The loose shelly pieces we found abundantly for fully one third of a mile along the mountain side, and at length the conglomerate rock itself was plainly seen adhering to the extreme western nearly vertical face of the trap mass, west of the Worcestershire beacon, in a situation contiguous to a large excavation of the lower Caradoc sandstone (Phillips, 1842).

In his later memoir on the geology of the district, Phillips describes the location in identical words except for the final phrase '..... west of the Worcestershire Beacon, in a situation laid open by a large excavation close to the road, and north of the little stream' (Phillips, 1848, p. 67)

Phillips's two sketches of the exposure are shown in Figures 1a and 1b. The former is a detail. The second is a part of his stratigraphic diagram. Figure 1 includes, for comparison, the known sketches of other conglomerate exposures in the West Malvern area, described later in this article.

**[Figure 1 hereabouts]**

### **3. POSSIBLE LOCATIONS FOR THE DISCOVERY**

Over the last sixty years, at least three locations have been suggested for the exposure, apparently based upon the above descriptions. They are at the Sycamore Tree, the Hay Slad Quarry and the Dingle. Their positions are shown in Figure 2.

**[Figure 2 hereabouts]**

#### ***The Sycamore Tree exposure [SO 7647 4593]***

The least plausible is the location known as the Sycamore Tree. This exposure, now poor, is the only known current exposure of Miss Phillips's Conglomerate at West Malvern. It is fossiliferous. Hardie (1974) appears to suggest this as Phillips's site but his wording is somewhat ambiguous. The current British Geological Survey memoir expresses the view that 'this is near the locality described by Phillips' (Barclay et al., 1997). This echoes the view in the BGS Technical Report on the area (Barclay, 1990). Bullard accepted this location as the discovery site (Bullard, 1975, section 4.5.2).

This site can be discounted as it is not near a road or stream and can hardly be described as west of the Worcestershire Beacon. It may well be the place where Ann Phillips initially found loose pieces of the conglomerate 'in the middle of heaps of fallen stones' and 'on the western flanks of ... North Hill and Sugar-loaf Hill'. Alternatively, it is quite possibly the additional site, which she later discovered in 1844, apparently revealing the conglomerate *in situ* (Phillips, 1848, p. 69).

#### ***Hay Slad Quarry [SO 767 449]***

Bennett (1942) believed that the location was in or near Hay Slad Quarry but had been lost by quarrying or covered by quarry spoil. This is plausible. The quarry is near what is now a track but was then probably the road. It is north of a small stream, now fed to tanks for the Hay Slad roadside spring. It is definitely on the western flanks of the Worcestershire Beacon. Furthermore, Bennett claimed to have found large Malvernian pebbles, as from the conglomerate, on the western edge of this quarry in the 1890s. Bennett's view is supported by

Symonds's (1855) apparent mention of this site ('the large quarry between the Wyche and West Malvern') as showing the conglomerate, but not the others to the north.

Although this site accords with the descriptions in Section 1, it is shown in Section 4 not to be the correct site.

### *The Lower Dingle Quarry [SO 7650 4562]*

The most popular current opinion for the discovery site is at the Dingle.

The location is currently seen as a long-defunct roadside quarry. This quarry is apparently unnamed. We have chosen to call it the 'Lower Dingle Quarry'. It forms the present parking area at the Dingle, immediately south of the bus terminal at West Malvern, and also extends about 18m north of the bus shelter (Fig. 3). [Figure 3 hereabouts] (The other important geological site in the locality is the well-known Dingle Quarry. This is 40m to the northeast.) The quarry face is about 20m from the West Malvern road and extends about 67m northwards from a little stream. The stream is now visible over the bank on the west side of the road and still flows, mostly underground, down the Dingle valley from high on the hill (Mathon, Herefordshire tithe map, *ca.* 1840). The location is very near, although not on, the western slopes of the Worcestershire Beacon. The present quarry extends on both sides of the Silurian/Precambrian junction. A large sandstone excavation (on the west side of the junction) now consists only of low spoil heaps. The eastern part extends about twelve metres into the Precambrian. This quarry therefore fits quite closely the description by Phillips.

Fossiliferous conglomerate has been recorded at least three times in this quarry during the 20<sup>th</sup> century although no observer explicitly claimed it as the location of the Phillips's discovery.

- i)* The most recent occasion was a visit by the Malvern Field Club in 1942 (Bennett, 1942a).
- ii)* In 1913 the Sedgwick Club of Cambridge University sketched the north face of the quarry (Fig. 3, location 1), showing the junction of the 'May Hill conglomerate with the Archaean' on the west side and about 3m below the quarry rim. They commented as follows;

A good exposure was not obtained but the approximate position of the junction was seen, weathered shell fragments being observed to rest on undoubted Archaean 'syenite'. The plane of junction was seen to dip about 80° to the west (Anon, 1913).

Pieces of May Hill Sandstone can be found today on the quarry spoil heaps immediately west of the quarry.

iii) Previously, Groom, in his field notebook, sketched an exposure (Fig. 3, location 1) in a manner very like Phillips's, describing 'Llandovery shales and conglomerate (Miss Phillips) mixed up with pieces of Malvernian series. Evidently the rock more or less of a fault smash. Many fossils.' and 'Schists slope ???? 99° at 70°; Fault dips 101° at 86°' (Groom, 1900, pp. 195-196). (???? here represents undeciphered handwriting.) His published work on this area mentions neither conglomerate nor fossils at this location and yet his notebook entry makes it clear that he saw them (Groom, 1900a, p. 150). Groom's sketch is shown in Figure 1d.

Others have observed the junction in the quarry without noting the presence of conglomerate or fossils (e.g. Smethurst, 1936, p25).

An excavation to the south (Fig. 3, location 5) in the 1980s by the BGS exposed the Precambrian/Silurian junction but did not reveal any conglomerate (Barclay 1990). However, this location lies on the other side of a major fault which crosses the Malvern Hills and separates the Worcestershire Beacon from the hills to the north.

#### ***Other possible locations***

Any other location where the Silurian/Precambrian junction lies in or very near a quarry near the Worcestershire Beacon and to the north of a small stream must be reckoned a possibility.

North of the Westminster Arms Quarry there is a major spring, now piped to houses lower on the hill, which must once have sourced a stream [SO 7647 4617]. This, however, is far from the Worcestershire Beacon and there is no quarry nearby to the north.

There is an old excavation north of the track leading from the road uphill into the Dingle valley (Fig. 3, position near A) [SO 7648 4568]. An exposure of the junction, sketched by A. H. Green (Fig. 1c), has been said to lie here (Barclay, 1997, p. 23). In fact, Green's notebook clearly shows that the exposure was in the Lower Dingle Quarry at location no. 2 in Figure 3 (Green, 1892). He states, though, that the junction was traceable into the area near A. The site A is near neither road nor stream. Nor is it contiguous to a large excavation of the lower Caradoc sandstone (May Hill Sandstone). This possibility, too, may be discounted.

#### **4. ADDITIONAL INFORMATION**

Additional information is found in the writings of Phillips and others and resolves the puzzle without ambiguity. The various other descriptions and mentions of the occurrence of the conglomerate west and northwest of the Worcestershire Beacon are noted below.

## **De la Beche correspondence**

The date of the discovery was 1<sup>st</sup> August 1842 (Phillips, 1842). A letter to Henry De la Beche written on 5<sup>th</sup> August 1842 invites him to inspect the site (Phillips, 1842a). The subsequent visit took place as mentioned in the paper, which is dated 19<sup>th</sup> September 1842. A search in the De la Beche archive at the National Museum of Wales has revealed nothing of further help (T. Sharpe, pers. comm., 2005).

## **Phillips's field notebooks**

Phillips's notebooks of the time (at least, the ones kept in the Oxford University Museum), for 14<sup>th</sup> July to 7<sup>th</sup> Sept 1842 (Phillips, 1842b) and for 4<sup>th</sup> to 6<sup>th</sup> Aug 1842 (Phillips, 1842c) make no mention of the conglomerate. Nor does his 'Malvern Hills' notebook, which was completed a little earlier (Phillips, 1842d).

## **Other exposures of conglomerate reported by Phillips**

The local geologist W. S. Symonds, writing within about a decade of the discovery, makes no explicit reference to any Phillips sites but refers to the Caradoc conglomerate 'on the flanks of the great quarry between the Wyche and West Malvern' (Symonds, 1855), probably meaning the Hay Slad Quarry as discussed in Section 3. This mention may well stem from the 1854 description by Phillips of a fossiliferous conglomerate band at the western side of an unnamed quarry (Fig. 1f) (Phillips, 1854). Phillips comments that it 'probably equals the Worcester Beacon Conglomerate', so the site is clearly a different one from the 1842 discovery.

Phillips's sketch shows a quarry with a disposition similar to that of Hay Slad Quarry and, like it, having notable epidote veins (Penn and French, 1971, p31). If Hay Slad was indeed the location of Phillips's 1854 find, then it was not the location of that in 1842. The 1854 conglomerate site would lie at about position C in Figure 2. (Symonds's book of 1855 (page 56) seems to be the first time in print that the conglomerate was named after Ann Phillips ('The Caradoc conglomerate of Miss Phillips').)

The next page in Phillips's 1854 notebook shows a conglomerate section (Fig. 1e). This section is not necessarily the same as the one just referred to. It is described as lying '50 yds N of the Beck' and so may represent a further exposure in the Lower Dingle Quarry. In this case, it would be at about position 3 in Figure 3.

## **Phillips's 1857 lecture**

In a later lecture, Phillips (1857, p. 5) refers to 'the discovery of this remarkable deposit by a lady resident at Malvern, in 1842' and it being seen 'at the western foot of the Worcester

Beacon'. Furthermore, he writes of 'the little glen which descends westward from the north side of the Worcester Beacon and passes by the shelly conglomerate bands just mentioned'. This geographical description can only refer to the lower part of the Dingle valley.

### **Other descriptions in Phillips's 1848 memoir**

The 1848 memoir contains other important references to the site.

*i)* Page 65 carries two references to the little stream. Firstly, it 'descends on the north-west side of the Worcester Beacon'. Secondly, 'on the south side of the little rivulet a group of purplish and grey sandstones is quarried for walling'. The later mention of 'the little stream' on page 67 is clearly, in the context, a reference to the same watercourse. An old Malvernian and sandstone quarry does indeed lie just to the south of the Dingle.

*ii)* A key statement appears on page 73. This page shows a section which is stated to start at the conglomerate bed described (the location in question here) and to extend to the 'west, where the Mathon Park road crosses the little valley, in the lower part of the Wenlock shale' (now called the Coalbrookdale Formation). Figure 2 shows the local geological boundaries taken from the BGS 1: 10 000 mapping (British Geological Survey, 1990).

Phillips gives the thickness of the Caradoc (May Hill) sandstone as 'nearly 500 feet' and the succeeding series of limestone and shale beds (the Woolhope Limestone) as 146 feet, giving close to 640 feet (194m) in total. The horizontal measurement of total thickness from the BGS mapping is 196m for the section westward from the Dingle. This apparently good agreement takes no account of either the ground slope (about 11°) or the non-verticality of the bedding (about 70° reversed dip) but, for these angles, the error is less than 1%. The equivalent horizontal measurements for the Sycamore Tree and Hay Slad locations are 209m and 166m respectively. These figures support a conclusion that Phillips's conglomerate site was in the Lower Dingle Quarry.

Most conclusive is Phillips's statement that the Mathon Park road crosses a little valley in the Wenlock Shale nearly due west of the site. Mathon Park is shown in Figure 2. The road to it is from the north and has the long-standing name of 'Park Road'. The stream crossing is on Wenlock Shale (Coalbrookdale Formation) and in a little valley. This can readily be identified with the point labelled B in Figure 2. In the area west of the Sycamore Tree exposure this road does **not** lie in the Wenlock Shale. This exposure is therefore definitely excluded as Phillips's site. West of the Hay Slad site, a route towards Mathon Park does cross a little valley but the crossing is **not** on Wenlock Shale (Figure 2, location A). Furthermore, this route is only a footpath and was so only forty years after Phillips's work, being shown as a

path on the Ordnance Survey map of 1886. Inspection on the ground confirms this route's unsuitability as a road. The Hay Slad location is therefore also definitely excluded.

It is concluded that the discovery of the *in situ* Miss Phillips's Conglomerate was made in the Lower Dingle Quarry.

## **5. THE POSITION OF THE EXPOSURE AT THE DINGLE**

An attempt is made here to further define the exact position of the exposure seen by Phillips at the Lower Dingle. This depends upon the interpretation given to certain words and phrases used by Phillips and others in describing the location. Information from the local history of the area is also important.

Phillips's sketch of the exposure shows the 'trap' (Malvern igneous rock) on the right hand side, labelled as the eastern side (Phillips, 1842). The exposure therefore faced generally to the south.

In the quotations already given, the exposure is described as '.... in a situation contiguous to a large excavation of the lower Caradoc sandstone' (Phillips, 1842) and '.... in a situation laid open by a large excavation close to the road, and north of the little stream' (Phillips, 1848, p.67).

Phillips gives a further description of the site.

On the western side of the Worcestershire Beacon, Silurian strata come up to contact with the syenite, on the side of the little rill. On the north side of this small stream the trap has long been exposed by excavations for the road, and here we were so fortunate as to discover *in situ* the shelly conglomerate which had been found loose on the hill above at various points (Phillips, 1848, p. 34).

This statement is rather unclear concerning the excavation. Was the trap exposed by excavations for roadstone or simply to make a route for the road? In either case, it seems most likely that it was rock adjacent to the trap which was the main subject of the excavation and not the trap itself. The trap was exposed on the side of this roadstone quarry. This is in keeping with the exposure being "contiguous to a large sandstone excavation". The present quarry in the igneous rock is now a major feature but is not mentioned and so probably did not exist as an important feature in 1842. This is consistent with the history of the major residential development of the village of West Malvern immediately to the north (Goodbury, 1994). This took place in the 1850s and generated a large local demand for Malvern rock. The nearby quarries before that time were very small.

Assuming the line of the Silurian/Precambrian junction shown in Figure 3 to be accurately drawn (British Geological Survey, 1990), several points are clear.

- a) Construction of the road at its most easterly point at the Dingle required the removal of some of the sandstones.
- b) This excavation would almost certainly have exposed the surface of the Precambrian and probably penetrated a little way into it.
- c) The area to the north between the junction and the road is probably the location of the 'large excavation of the Caradoc sandstone'.

This is a situation which completely fits Phillips's descriptions if, at that time, the present Precambrian quarry had not yet been dug. It is probable, therefore, that the original exposure was close to the most easterly point of the road and very near the north bank of the stream.

**[Figure 4 hereabouts]**

The 1840 tithe map of the area shows a nearly semicircular area extending about 17m north from the stream and on the east side of the road (Fig. 4). (This area has been labelled X in various figure captions.) The tithe map does not indicate the significance of this area, which apparently was not enclosed by a fixed boundary; it was presumably a level area of some sort or a quarry. It seems likely that this may be identified as the area described by Phillips as 'a large excavation close to the road and north of the little stream (Phillips, 1848, p. 67). The most likely situation is that Phillips's exposure was near the northern extremity of this area, where it is crossed by the geological boundary, i.e. within a very few metres of SO 76505 45605 (Fig. 3, location 4 and Fig. 5 arrow).

## **6. THE LATER DEVELOPMENT OF LOWER DINGLE QUARRY**

Following the 1842 discovery, the Lower Dingle is not described in any publication until the production of the first large scale Ordnance Survey map of the area in 1886. This shows all of the local quarries in more or less their present form. It appears that they were all active mainly in the 1850 to 1880 period to provide building stone for the development of West Malvern, as mentioned earlier.

The unpublished work by Green (1891) locates and depicts a section that includes the geological boundary (Fig. 1c). The section can be accurately located from Green's notes at 13yds (11.5m) south of the north face of the Precambrian quarry and on the western edge of the quarry. It was on the site of the present public toilet (behind the bus shelter) or just behind

it, where there is still a low bank [SO 76487 45641] (Fig. 3, location 2). Clearly, the quarry in the Precambrian was largely dug by 1891.

The exposure shown by Groom (1900) was on the north wall of the present Precambrian quarry (Fig. 3, location 1).

**[Figure 5 hereabouts]**

**[Figure 6 hereabouts]**

By Groom's time the quarry was very close to its present form and a picture postcard photograph of 1907 (published by Frith, no. 59015) confirms this (Fig. 5). A photograph of the Lower Dingle quarry at present is shown in Figure 6.

## **7. CONCLUSION**

It is concluded that the location of the discovery of Miss Phillips's Conglomerate is at the Lower Dingle, in what is now the car park. The exposure has long since been removed by quarrying, probably in the 1850s. Its position can be defined within a few metres, close to the former course of the stream in the Dingle valley. This position satisfies Phillips's persistent description of the location as being on the west side of the Worcestershire Beacon, which is otherwise never quite accurate, even in the northern part of the quarry.

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