The Kirkstead (Woodhall Spa) Coalfield

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Introduction.

Woodhall Spa is situated midway between Lincoln and Boston, just east of the River Witham, in Lincolnshire. The settlement developed in a sparsely populated area within the joint parish of Langton and Woodhall around a source of spa mineral water. This water was found flowing from an abandoned trial shaft for coal. Allegedly sick cattle in the field drank this water and were cured. The local landowner, Thomas Hotchkin, then built a small bath house which from the 1830s onwards gained an increasing reputation as a centre for curing gout and arthritic related illnesses. A national reputation developed with the building of the railways and popularity continued until the First World War. Afterwards the spa continued on a slowly declining scale but supported by a rheumatism clinic run by the National Health until the collapse of the Spa Baths shaft in 1983. The spa water was strongly saline and contained high concentrations of bromide and iodine assumed to be essential for the cures. Few records were made of the original sinking but the source of the water was the Kellaways sandstone found at the base of the Upper Jurassic.1

The Spa Baths shaft was one of several attempts to find coal within this area during the early nineteenth century. Very little information about this mining operation exists. This paper discusses the documentary evidence for these trials for coal and the geological rationale behind their sinking in this area which, contrary to general belief, was not an attempt to access the much deeper Carboniferous Pennine coal deposits, but imagined local coal seams within the Upper Jurassic clays that outcrop on the east side of the River Witham.

Local demand for coal.

By the early nineteenth century the agrarian and industrial revolution was well underway. The parish of Langton and Woodhall had been enclosed in 1767 to 1769.2 Land and agriculture profited from the Napoleonic Wars and Corn Laws. The rural population was gradually increasing3 and the areas of woodland decreasing due to enclosure and land clearance. Consequently, with the rising cost of firewood there was an increased demand for coal for domestic, and increasing industrial, use. Transportation from the Pennines, where the existing coal fields were, was slow and relatively expensive.

Choice of area.

Although an unlikely place today, the Kirkstead and present Woodhall Spa area was a logical place for a coal prospect with the geological understanding then available. If successful the area would have been a local source of cheap coal.

In January 1816, Edward Bogg, a land surveyor from Louth, presented a paper to the Geological Society on the geology of the Lincolnshire Wolds area.4 Although this paper was written after the earliest coal trials, it defines local knowledge that must have been accumulating in the area since the Enclosure Acts which encouraged ploughing of large areas of the landscape, illuminating the surface geology on a large scale for the first time.

Edward and his brother Thomas Bogg, from Louth, also put down a bore 103 yards (92.2m) deep near the village of Dighton-on-Bain and described various bands of ‘Bituminous Schist’ which they encountered. This bore was in the ‘Shale’, also called by local names ‘Clunch Clay’, or ‘Blue Blind’, referring to the Jurassic clays, including the Kimmeridge Clay which contained bituminous shale often seen outcropping in the small streams of that area and elsewhere towards the River Witham. The thickness and the geological nature of these clays and shales were then unknown.

Bogg tested his ‘bituminous schists’ which burnt with an offensive smell due to the presence of pyrite (sulphur). However, he recorded,

those beneath the depth of 80 yards (73m) were less disagreeable.

Bogg describes bands at about this depth as burning like ‘jetty’ coal, a hard fine grained pure form with little visible structure known as sapropellic coal. Bogg also concluded that there were possibly better seams of ‘jetty’ coal (which he said the local people called ‘gromel’) deeper down.

The first attempt to correlate the surface geology of the whole of England had been William Smith’s geology map of England, published in 1815.5 This map included Lincolnshire, but showed only the major geological units and escarpments. It is estimated that about a total of 400 copies of this map were produced so its content was probably not general knowledge within the first few years of publication.

Edward Bogg published his own map within his paper.6 It is much more detailed than Smith’s map and, due to the scarcity of Smith’s map, may have been the only source of local geological information available at that time.

Bogg’s map, which includes a geological cross-section, clearly defines most of the units recognised today and the section shows deposits described as ‘Alluvium of Chalk’, now known as the Calceithope Drift, and ‘Alluvium of Shale’, now referred to as the Wragby Till (Fig.1). These were then thought to be fluvial, a relic of the biblical flood but are now known to be material deposited by glaciers.

Bogg also describes the floods which formed these ‘alluvia’ of having flowed from east to west, since west of the chalk Wolds the beds were chalk rich (Calceithope Drift) and further west, shale rich (Wragby Till). Bogg states that these alluvia included rocks seen in the Wolds, other stones, shale and coal, some similar to the ‘bituminous schist’ and ‘jetty’ coals found towards the bottom of the Dighton-on-Bain bore.

Consequently, he inferred that these coal and shale fragments could be ‘strong indications of coal’ and that good ‘jetty’ coal seams within the shales would be found just under the alluvium to the west of the Wolds.

Bogg argued that the closeness of these jetty coal seams to the surface and their extensive distribution was further evidenced by the large quantities of coal fragments washed up on the Lincolnshire coast. Although some coal presumably originated from passing ships conveying coal from the northeast to London, Bogg reasoned that the bed of jetty coal in the ‘shale’ or ‘Clunch Clay’ must extend under the chalk mass of the Lincolnshire Wolds and must be shallow enough to be eroded by the sea and the coal fragments to be deposited on the beach (Fig.2).7
The concept of huge lowland glaciers depositing the 'alluvium' on both sides of the Wolds, and melting, after having brought stones and coal from the north and Pennine areas, was not recognised until the work of James Geikie in 1874. Consequently the early entrepreneurs did not realise that many of the better quality coal fragments came from those areas and not from the local shale now known to be the Kimmeridge Clay. The North Sea washed coal from glacial deposits on the east sides of the Wolds and deposited it on the beaches.

To the nineteenth-century miner, Bogg's borehole showed that the quality of coal increased with depth and it would be logical to look for the main seams where these beds in the 'Shale' came to the surface. Since Bogg described the easterly downward dip of the beds, the logical thing to do was to travel westwards from the Wolds until the lowest beds outcropped at the surface. Away from the Wolds they found that the amount of 'alluvium' decreased in extent and thickness but still carried coal fragments and bits of shale. The west side of the Witham was covered with marsh deposits of the Witham Fen, then still largely undrained, whilst the east side contained higher, well drained areas of sands, gravel and 'alluvium'. Ditch clearance and brick pits, especially between Kirkstead and Bucknall, including the present Woodhall Spa area, showed that Bogg's 'shale' was present beneath a thin layer of 'alluvium'.

Consequently, the coal entrepreneurs, eager to test Bogg's theories, did not expect to have to go to any great depth to find the 'jetty' coal when sinking their 'coal mines' in the shale outcropping in the general area of Kirkstead and Woodhall Spa. Naturally the coal entrepreneurs looked for sites where the alluvium was thin or absent. They would have realised that the coal of Yorkshire, Derbyshire and Nottinghamshire also dipped eastward, and even if they assumed that coal to be sufficiently extensive, they would have realised that at the distance the area was to the east of the Pennines, the Carboniferous coal seen in the Pennines would be much too deep to be accessible by nineteenth-century technology.

Any area selected for a trial shaft would also need a transport network to allow the export of coal to local markets and to bring in any equipment. Roads were then in a poor state in the area, but the River Witham had established river ports at Kirkstead Wath (Wharf), Stixwould and Bardney from where local agricultural produce was exported and manufactured goods imported. There was also a small steam packet which plied between Boston and Lincoln, calling in at Kirkstead twice a day, going and returning. Kirkstead Wath was particularly well developed with a cut extending towards
the windmill at the bottom of Mill Lane where barges were loaded and repaired. From Kirkstead the old medieval road, joining the former monasteries, ran north-south along the east side on the River Witham, between Tattershall and Bardney, and tracks ran alongside the several parish boundaries, eastward towards Horncastle. The area, in 1800, was sparsely populated outside the villages; parts of Kirkby and Martin Moors were still undeveloped agriculturally. The sandy elevated well drained areas of the Moors formed ideal sites to prevent flooding from surface water and to assist disposal of unwanted mine water in nearby streams. Since the area was agriculturally undeveloped entrepreneurs would not have to buy or rent good farm land to site a trial shaft (Fig.3).

Remembering that the present settlement of Woodhall Spa only developed after the Spa this appeared to be an ideal site both geologically and economically.

Early attempts.

The date often given for the digging of the coal mine at Woodhall Spa is 1811 which seems to originate from a reference in White’s Directory of 1842 stating that the well was sunk ‘about 30 years ago’. Later directories then quote ‘about 1811’, or 1828 the date given by the Geological Survey in 1877. However, there is no evidence for any shaft before 1813, though in view of the speculative interest, unsuccessful trials may have been conducted in the area and abandoned before any depth was reached, therefore not warranting a mention in the nearest local newspaper, the Stanford Mercury, based fifty miles away.

The earliest reported attempt to look for coal is noted in the Stanford Mercury of 23 July 1813.

Mr Thompson of Billinghay, a Yorkshire man and acquainted with the usual indication of coal, was induced by appearances to have his land on Kirkby Moor bored. At a depth of 93 feet (28.3m) coal was found, into which he bored 4 to 5 feet deeper (1.2 to 1.5m) and found it better as he went.

The Stanford Mercury also reported that men were employed digging a shaft and that ‘the Moor is a mile from the River Witham’.

A reporter reporting on a coal mine in such a remote area may well have been uncertain which was the nearest village, or which parish he was in. He may have named the last settlement he travelled through to get there irrespective of whether it was the nearest, or confused the names. Therefore the area of Kirkby Moor, described in the report as a mile from the River Witham, between Horncastle and Tattershall might be the area west at Kirkby Moor near Kirkstead, the gravely area to the north of Kirkstead village, but east of Kirkstead Wash, or anywhere in that area ‘about a mile from the River Witham’.

Conway-Walter mentions a Mr. J. Clarkson of Moorby who had some previous experience among Yorkshire coal mines advising John Parkinson in digging his coal mine (see also below). However, Conway-Walter suggests only one shaft, putting all his information together. There is certainly evidence for more than one trial shaft and Clarkson may have been involved with one of these rather than the later Parkinson shaft that Conway-Walter concentrates his reports on.

The data only starts to fit if several trials were undertaken in different places and at different times. This is often confused by later accounts mis-quoting earlier written evidence.

In his paper read to the Geological Society, Edward Bogg had encouraged landowners to band together to defray the cost of sinking trial shafts. Despite early attempts being unsuccessful, the ‘indications of coal’, outlined in Bogg’s academic paper, must have seemed convincing.

Kirkstead shaft, 1819.

Response to Bogg’s paper of 1816 seems to have been manifest in the Kirkstead mine.

This shaft sunk in 1819 seems to have been owned by Samuel Staniforth, a builder from Boston, who styled himself the proprietor of the Kirkstead Coal Mine. Whether he took on the existing shaft dug by Mr Thompson in 1813, or dug a new one is unknown. The site of the Kirkstead shaft according to local information was in a field now occupied by Abbey Drive, behind a former chapel, now demolished. This is about three-quarters of a mile from the River Witham and thus might be the 1813 shaft. This distance is a reasonable approximation when one considers that the only large scale map then available, surveyed by Captain Armstrong in 1764 was very inaccurate and frequently three-quarters of an inch on the map represents one mile, rather than one inch to the mile given on the scale. The old shaft could have been opened up after six years if not too derelict, though Granville who tends to be a careful reporter quotes a local physician that the mine was sunk in 1819 so there may have been two in the same area, the earlier one, of Thompson, now abandoned and possibly filled in.

Whether a new shaft or the old one, Staniforth must have known about the earlier trials and their presumed failure since if successful it would have been reported. Possibly he was convinced by the ‘indications’ of coal on the ground (fragments in the ‘alluvium’) and Bogg’s assessment that good

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Fig. 2. Geological section through the Lincolnshire Wolds as imagined by Bogg in 1814-16, showing how seams of jetty coal in the shale could be found on both sides of the Wolds (adapted from plate 24, Trans. Geol. Soc. 3 (1816) and accompanying paper).
coal lay just beneath the surface. Thus all he had to do was to dig that bit deeper with a slightly bigger operation to be successful.

Conway-Walter mentions the legend of a well as being 'not far from Mill Lane near the Kirkstead Station.' It is difficult to know whether Conway-Walter is describing the location of Mill Lane or saying that the well was near the Kirkstead Station. Since, even in Conway-Walter's day, there were only fields between Kirkstead Wath and Woodhall Spa, his description is still plausible for both possibilities.

Granville, quotes that this 'mine was sunk 100 yards, then bored 100 yards' (100 yards equal 91.5 metres) before it was abandoned. Assuming the depth is correct they should, with ascending dip, have penetrated the Kellaways and may have entered the Lincolnshire Limestone, though these rocks may be deeper there since there is a suggestion that there may be a series of faults extending north-south along the line of east side of the River Witham, with a small rise to the west.

George Weir's Sketches around the Town and Soke of Horncastle, published 1 May 1820, contains a revised geological map by Edward Bogg and notes based on Bogg's paper. Weir states that the shaft at Kirkstead was 150 yards deep (137.2m), all within the 'Churn Clay', again 'testifying to the great depth of this stratum'. Allowing time to go to press the figure was probably correct in late 1819.

This may be reinforced by an item in the Stamford Mercury of 14 July 1820 Samuel Staniforth, builder from Boston and proprietor of the Kirkstead Coal Mine tries to sell eight shares (there were twelve in total) in order to find further capital to invest in his mine which he has been unable to work for some time. He then continues to exhort the public benefit the success of the mine would offer and his conviction that good coal lies just a little lower down.

However, clearly Staniforth was struggling financially with the venture and on 8 September 1820, Samuel Staniforth called a meeting at the George and Dragon Inn, in Horncastle, for interested parties to see what assistance they can give him in order to continue with the mine.

However it was reported that one night the bells of Horncastle were rung to announce coal had been found at Kirkstead, and on 15 December 1820, it was reported that there was a discovery of a two and a half inch (65mm) seam of coal of excellent quality in the Kirkstead mine at eighty-six yards (78.6m) depth the week before. Combustion tests were made at Mr Merryweather's at Lincoln, and that the miners expected more coal to be found at ninety-four yards (86m). The report mentions that the mine had been in existence for some time.

These items are interesting. They are either carrots by Staniforth to his creditors and backers, or he genuinely found money to continue, in which case the depth reported as eighty-six yards may have been a misprint for 186 yards. However, the shallower depth may also suggest another attempt in the same area.

Clearly Staniforth did not realise sufficient capital to continue for any length of time and, probably early in 1821, the Kirkstead shaft was abandoned at 200 yards (182.9m) 'through want of money'.
A solitary surviving well-sinker, who died in 1897, said that the Kirkstead well was filled in because the water was too salty to drink. Conway-Walter comments that possibly the water just tasted strongly of iron since many of the surface wells were bored into the gravels and were iron rich and "ferr" (iron stains) the water bottles. This well may refer to a drinking well but may also be based on memories of the old Kirkstead shaft filling with water after it was abandoned and then, once it was realised that the water being salty might poison the cattle, filled in.

George Overton, a local resident, heard from his father that during the sinking, they hit a hard rock layer and when this was punctured, the water spurted up in a great gush. Overton's father also remembered that the head gear fell into the Kirkstead shaft several times during the sinking. This may suggest that they pierced the same hard Kellaways Sand Rock, allowing water to escape from the underlying Kellaways sandstone as was later encountered in the Spa Baths shaft. The Spa Baths spa water was similarly strongly saline.

There is no record of any other major shaft at Kirkstead.

Spa Bath Shaft, 1821.

Granville states that 'immediately after the discontinuance of the attempt to find coal at Kirkstead, a gentleman sunk a shaft about a mile to the east'. This also suggests that Overton's site for the Kirkstead Mine is correct since it is about a mile to the west of the Spa Baths Well (Fig.3).

The date of 1811 given by various authors, for the sinking of the Spas Baths Shaft seems to have no basis in fact. Evidence supporting Granville for post 1819 comes from Weir's book of 1820, since he mentions only the Kirkstead shaft. The 'gentleman' mentioned by Granville was John Parkinson, a land speculator from Bolingbroke. Between 1796 and 1821 Parkinson bought land in the Parish of Woodhall, which then a combined parish with Langton, extended as a strip from near Horncastle, west, south-west down to the River Witham. The Napoleonic Wars and the Corn Laws kept agricultural land prices high stimulating continued land enclosures and draining of the West, East and Wildmore Pans from 1800. Parkinson's speculative deals seemed to pay off as land prices doubled but over investment in his other projects, based on mortgaging land at this high value led to insolvency during the post Napoleonic War depression and land prices fell.

Parkinson was granted a licence to mine on 'The Lands in the Honour of Bolingbrooke' in 1821. This would be in the area where Parkinson founded his new town, now called New Bolingbroke, situated on the River Witham. It is possible that the indications of coal discussed above, which would have been less evident in the fen deposits in that area, persuaded Parkinson that the Kirkstead area was the better option. Why Parkinson should start to dig about one mile east of the Kirkstead mine is unknown. Parkinson must have been very committed to the site and the possibility of coal, since he did not even put down a test bore before digging, surprising, in view of the recent demise of the Kirkstead Mine. This may be explained by John Parkinson's eagerness to fulfill his ambitions which allegedly were to plant a forest, found a town and own a coal mine. The choice of site may also have been influenced by the local Lord of the Woodhall Manor, Thomas Hotchkinn, who had the mining rights in the parish. The Enclosure award shows that Hotchkinn owned the land on which the Spa bath Well is situated at the time of the award. Therefore, Parkinson may have rented and Hotchkinn may have influenced the site location and even had a financial interest in the enterprise.

The shaft, according to Conway-Water, was supervised by a Mr J. Clarkson from Moorbey (near Horncastle) who was experienced with Yorkshire coal mines. However, as discussed above, Clarkson may have been only involved with the earlier shafts.

The Spa Baths shaft was probably worked by the 'stage and ladder' method. Most of the work probably done with pick and shovel and the circular shaft bricked downwards as they went. The brick courses were laid dry and at regular intervals oak blocks were set in to form rings, so fixings and stages could be constructed for ladders. The rock waste was probably removed using a windlass operated by hand or a horse gin. The upper brickwork with oak rings is visible in figure 4, beneath the square box.

At 170 yards (155.5m), they hit a fissure full of saline water, this was to become the future spa water. Granville's visit in 1839, to the then embryonic Woodhall Spa Baths, stimulated interest in having the origin of this water investigated. Two men who worked on the original shaft to contain this water flow recorded their statements in October 1839.

Firstly Cheeseman stated that the base of the source rock was 180 yards (164.6m). Water oozed from every part of the source rock but especially from a deep fissure, the water flowing east-west, and that this rock which was a 'soft spongy grey stone and easily cut with a knife is 18 yards thick' (16.5m). A conduit was built to convey the water around the back of the shaft and the source rock lined with cemented brickwork.

Secondly Belton, confirmed the depth at which the cemented brickwork commenced and that they rapidly worked upwards, working day and night for eighteen yards (16.5m). He gave the direction of the fissure as south-east by east, north-west by west and said that they were engaged in laying this cemented brickwork in October 1822.

Granville comments on the possible geology of the Spa Bath's Shaft, probably after gaining a greater understanding of national geology, possibly assisted by Smith's maps which by then would have been better known. He records

that although no record was kept of the strata passed, and from information and specimens received the sinking commenced in the clunch clay, which was found to be 120 yards [110m] in thickness; they then passed in succession through forest marble, Combrash, oolite, Bath freestone, Lias, clunch clay again.
Today it can be deduced that the fissure was just beneath the Kellaways Sand Rock within the Kellaways Sandstone which is about six and a half metres thick, so it is likely that they encased all the strata in that part of the well which was friable and seeping water when they laid their cemented brickwork to a height of sixteen and a half metres. They used the Combrash Limestone which underlies the Kellaways as a solid base enclosing the Kellaways clay, and after constructing a conduit to drain the water from the fissure around the back of the shaft, continued, presumably in poor light and difficult conditions, to ensure they had contained the whole water problem, by encasing the flow from sandstone bands present above in the Oxford Clay. The cost of the exercise would ensure that they were unlikely to go higher than necessary but high enough to solve the problem.

In Granville’s description the ‘clunch clay’ is the Upper Jurassic Clayes which include the Oxford Clay at its base. Granville’s ‘forest marble’ is a rock which does not actually exist in Lincolnshire at this level but to correlate with his description the Kellaways sandstone can be inferred as being between the ‘clunch clay’ and Combrash.

On the 3 January 1823 the shaft had probably reached the Lincolnshire Limestone which is the rock described as ‘Bath freestone’ by Granville, since dynamite was required to penetrate the rock. The Stamford Mercury reported that two men were seriously injured in an explosion having stood too close to where the charge went off. Many of their bones were broken and some parts of their extremities completely blown off.

On 15 June the same year, when the shaft had reached a depth of 670 feet (204m) a further charge went off before two men could be hauled to safety, one William East was killed and a Mr Tyler was badly injured. According to Conway-Walter, the winchman at the top of the shaft was asleep and did not hear the yells or the tugs on the rope to pull the men to safety.

There are stories of miners going down with coal in their pockets and bringing it back up to report their findings. This may have been to guarantee their jobs or to encourage investors. Reports of coal found caused, according to the Stamford Mercury, “great excitement at John Parkinson’s residence in Bolingbroke, people of all classes including the poor flocking to give their money in the hope of profiting from the investment.”

However, by December 1826 Parkinson was bankrupt and the well was recorded as being in the possession of Thomas Hotchkin, the local squire. After the closure of the mine in 1823 it was covered over with heavy timber planks and by 1824 water had overflowed the top of shaft. Sometime between 1825 and 1829 the water seems to have gained a reputation as a cure locally leading to several reports in the Stamford Mercury by 1837, and the eventual building, by Thomas Hotchkin, of a Spa Baths and Hotel complex by 1839. This development seems to have been encouraged by Dr Granville who, when researching his book on the spas of England, encouraged Hotchlin to have the water analysed. The water was found to be rich in iodine and bromine which increased the spa’s reputation.

The flow into the well was insufficient to meet the demands of the Spa Baths resulting in building of the winters to allow for natural recharge. This led to many surveys being conducted and eventually it was recommended that adits be constructed. These were dug at 520 feet (158.5m) depth between 1889 and 1910, and it is these surveys that provide evidence for the actual source rock and rocks encountered in the shaft. Beneath the adit floor was still ten feet (3m) of cemented brickwork constructed by Cheeseman and Belton with seven foot six inches (2.3m) of Combrash Limestone below. Beneath this was twenty feet (6.1m) of un-cemented brickwork which enclosed the Great Oolite (Blisworth) Clay; and beneath that another exposed rock layer, the Great Oolite Limestone (the ‘oolite’ of Granville), which was twelve feet (3.7m) thick. Beneath that it was reported that there was alternating rock and brickwork down to beyond 750 feet (229m).

The original depth of the well was reported to be about 280 yards (256m). Measurements made by Hill & Co. in 1898 measured it at 806 feet (246m), once corrected for the adit depth, and the remaining depth can probably be accounted for with adit spoil and rubbish. The boring of 120 yards (110m) made beneath that, would have been easily filled and not subsequently measured.

Based on information from the adits and subsequent bored holes the probable depths of the strata encountered in the Spa Baths shaft are shown in figure 5.

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**Fig. 5.** Log showing the strata encountered in the Spa Baths Shaft. The narrow lower part represents the boring into the bottom of the 2.2-metre diameter shaft. The source of the Woodhall Spa mineral water was the Kellaways sandstone.
The bottom of the shaft may have stopped in the Marlstone (Middle Lias) or in one of the sandy limestones six metres or so below within the Lower Lias clays. The boring for a further 120 yards (110m) beneath suggests that Parkinson was becoming desperate to find his coal. This part was entirely in the Lower Lias clays, stopping in a pale coloured stone probably one of several thin limestones found within those clays.1

Conclusion.

This raises the question as to why they should dig so deep in the Spa Baths Well if they were only after the 'jetty coal' in the 'shale' mentioned in Bogg's paper. Bogg described the 'shale' as being of an immense depth. The excavation of the shaft may well have been supervised by Mr Clarkson, 'experienced with Yorkshire coal mines', or some other person who may have been unfamiliar with the Lincolnshire Middle Jurassic geology, and it is unlikely that the well sinkers would have known the thickness of each rock penetrated until they were through it. The fact that they found shale, the 'chuch clay' of Granville (now called the Lias clays), after penetrating the various sandstones and limestones, may have suggested to the miners that there was all within the same 'shale of immense depth' recorded by Bogg and the intervening limestones no more than a very expensive inconvenience.

Even the thickness of the Lincolnshire Limestone at twenty-one metres did not stop the excavation probably because it is not shown on Bogg's map or section and the well sinkers were probably unaware of the details of Smith's maps. Thus as discussed above they would not know when to stop.

It is known that the Upper Jurassic clays, especially those first bored by Bogg at Dominington-on-Bain contain beds of oil-shale and carbonised fragments that will burn to some extent. The Lias clays beneath the Limestones toward the bottom of the Woodhall Spa Shaft and underlying bire contain similar material in places though not so combustible. This indication of coal would have helped to keep the enthusiasm going in the mind of the miners.

About fifteen years ago the author was informed by a native of Woodhall Spa that during the war he retrieved a fragment of Woodhall Spa coal from another shaft near Armnhem Way, Woodhall Spa. This shaft, now filled in, was purposely sunk in 1904 for Spa water.

Although the Kirkstead Coal field was a failure in providing a source of coal for the inhabitants of central Lincolnshire the accidental interception of a saline spring resulted in the development of the Woodhall Jodine Spa, as it first became known and eventually the settlement of Woodhall Spa. The documentary evidence gathered to determine the source of the spa water after the Spa Bath's shaft was sunk and in particular the paper written by Edward Bogg not only gives an insight into the actual geology encountered in the various shafts, especially the Spa Bath's shaft, but contributes towards an understanding of the logic of coal mining in central Lincolnshire in the early nineteenth century.

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Notes.

2. Act for Dividing and enclosing certain Open Arable Fields, Moors and commons in the Parishes of Langton and Woodhall in the County of Lincoln 1767-69, (8 MARY 1769). This also included general enclosure of the outer areas of Martin and Thornton Moors at about the same time. Prior to this each of the above parishes shared common Moorland around Tower on the Moor. The Langton, Woodhall and Thornton parishes met at the present Woodhall Spa cross-roads. The Martin and Thornton villages were enclosed earlier under an earlier enclosure.
5. William Smith, Geological Map of England (1815). This map, called the 'Great Map', was the first full geological coverage of the whole of England and used fifteen separate sheets. About 400 copies were produced so it was unlikely that the information was common knowledge to the well sinkers.
8. James Geilicke, The Great Ice Age (1874), ch.XXX.
17. George Overton, One of several local residents who communicated various interesting letters of the early days of the spa.
18. Captain A. Armstrong, Map of Lincolnshire Comprehending Lindsey, Kesteven & Holland, surveyed 1776,7 & 8, scale one inch to one mile, engraved by Stephen Pyle (1778). First large scale one inch to one mile map of Lincolnshire probably made by triangulating between church towers, the areas between being filled in without a great deal of accuracy. This was checked with a 1:63,360 scale Ordnance Survey map for selected areas by the author.
20. British Geological Survey, Geological Map Horncastle Sheet 115, Solid and Drift Geology, scale 1:50 000 (1995). This map shows an inferred fault near the Witham in response to deeper structures. This does not prove the existence of a fault exactly where marked but that there is some evidence for one in that area.
22. Stamford Mercury 1 September 1820, p.3, col.4.
23. David N. Robinson, Book of Horncastle and Woodhall Spa (Buckingham, 1983), p.120.
25. For example, White's Directory of 1842, p.454; Conway-Walter, Records of Woodhall Spa and Neighbourhood, p.6. Many other directories and booklets give similar dates and in 1911 Woodhall Spa held a pageant to commemorate 100 years of the spa.
26. George Weir, Historical and Descriptive Sketches of the Town and Soke of Horncastle, p.100.
28. Act for Dividing and enclosing certain Open Arable Fields, Moors and commons in the Parishes of Langton and Woodhall in the County of Lincoln 1767-69. Page 33 of the Act, paragraph 'Savings to the Lord of the Manor', makes reference to the continuation of mining rights to be held by the Lord of the Manor, Thomas Hotchkin, after the enclosures had been completed.
29. Belton and Cheeseman. Two statements by those well sinkers regarding work carried in the Spa Baths shaft to contain the inflow of water flowing into the shaft. Recorded October 1839. Woodhall Spa Cottage Museum Archives.
31. Stamford Mercury, 3 January 1823.
33. Stamford Mercury, 11 August and 8 September 1837 and 6 July 1838.
34. Ibid., 20 December 1839, p.2, col.4.