THE SOMERSETSHIRE COAL CANAL CAISSON LOCK

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A. INTRODUCTION

My curiosity about the Caisson lock constructed on the Somerset Coal Canal during 1796-1797 was first aroused through an interest in the life and work of William Smith (1769-1839), geologist and civil engineer, and long regarded as the father of English geology. He was employed as surveyor and engineer by the Canal Company from 1793 to 1799 when he was dismissed ***(Eyles, 1969)***. His subsequent career might have been rather different had it not been for the Caisson as it seems that Smith's dismissal was connected with its failure.

Canal lifts in general have been described by Tew ***(1953)*** and Weaver ***(1965)***. The Caisson lock was the invention of Robert Weldon and it has been described in detail by Buchanan ***(1969)*** and Clew ***(1970, p. 164-166)***. Weldon came from Lichfield which was until 1781 the home of Charles Darwin's amazing grandfather Erasmus Darwin (1731-1802). Erasmus can be regarded as the innovator of the vertical canal lift and entered in his commonplace book (1777) a description of the principle on which the lift functioned. "Let a wooden box be constructed so large as to receive a loaded boat. Let the box be joined to the end of the upper canal and then the boat is admitted, and the doors of admission secured again. The box with the boat in it, being balanced on wheels or levers is let down and becomes part of the inferior lock". ***(King-Hele, 1968, p. 129)***.

Darwin envisaged counterweights rather than complete submersion in a water-filled cistern, but the similarity in design is enough to suggest Weldon might have got the basic idea from Darwin ***(Hadfield, 1969, p.265)***.

Weldon's age at his death in 1805 is unknown but his will (Lichfield Joint Record Office) which was proved 2 January 1806 shows that his father was then still alive. His brother James to whom he willed his tools and engineering models died on November 7 1841 (Will also lodged at Lichfield JRO). With these figures it is possible to reconcile the possibility that Weldon as an adult could have known Erasmus Darwin in Lichfield before the latter's departure in 1781. But nothing futher can be said until Weldon's age is known. It is interesting that Weldon's name still appears as a subscriber to William Smith's great geological map of 1815.

Weldon's particular lift was patented in 1792 and was one of several such lifts proposed about this time. Dr James Anderson's lift using two counterbalanced caissons ***(Clew 1970, p.28)*** was at first considered by the SCC ***(Anderson 1796)*** but its limited capacity favoured Weldon's. Weldon's contrivance is best described from contemporary notices. It was first suggested to the Canal Company proprietors as a means of changing levels at Combe Hay in 1795, and a model was submitted in June. lt was described in the Bath Herald for 27 June 1795, as follows:

"This ingenious contrivance consists of a wood cistern, having two square apertures with a slide door to each, at the respective levels of the upper and lower Canals; In this reservoir (being always full of water) is immersed a Caisson, or hollow vessel; having a door water-tight at each end, for the purpose of receiving and enclosing a boat; this Caisson is ballasted, to be specifically of the same gravity as water, consequently will descend or ascend in its surrounding medium (with or without a load) with the greatest facility. Each end of the Caisson, when brought in contact with the square apertures of the reservoir, is also water-tight; this is accomplished by an inverted valve, discharging the water from the space between the slide-door of the reservoir and the door of the Caisson, the pressure instantly then fixes the Caisson to the apertures, therefore the slide-door may be opened with much ease, and of course that of the Caisson. The boat may then be received for ascension, the doors re-shut, and the great difficulty of releasing the Caisson from the aperture (against which it was so powerfully pressed) obviated, by opening another valve to refill the space just mentioned; it consequently follows, the pressure on the Caisson will be as before, equal on all its sides - by discharging a small quantity of water from the Caisson by means of a cock into the lower Canal, it becomes lighter, and instantly ascends to the upper aperture; the same process with the valves completes the design which is truly philosophical".

The dimensions of the **Stone** Cistern as built were
81 feet long
20 feet wide (maximum)
61½ feet deep (not 88 feet as often stated)

The dimensions of the **Wooden** Caisson were
80 feet long
10½ feet wide
11½ feet high

(Bath Herald, 9 June 1798).

The depth of the lift achieved by the Caisson lock was 46 feet. The summit level of the Canal was about 240 feet above sea level. Thus the level in the exit tunnel would be at about 195 feet, ie. on a level with lock 8. The total drop of the Combe Hay flight was 134 ft. (not 154ft as Clew ***(1970, p.64)*** says) so that three caissons if all of equal drop would have been required at Combe Hay (see p. 9).

At first the lift worked well, and John Farey ***(1806, p.315)*** recorded that William Smith was one of those who passed through it during successful trials which took place during 1798 and 1799. Perhaps on June 4 1798, when a "scientific correspondent" reported to the Bath Herald (9 June 1798):

"It is a pleasure to reflect that the hydrostatical contrivance

for conveying of boats from upper to lower levels and vice versa, is completed, and may now be esteemed one of the greatest discoveries of the age; every scrupulous objection to the practability of its operation being removed.

On the 4th of June, in the presence of a large body of spectators, this stupendous machine underwent a complete trial. A little delay was occasioned by the inadvertency of the workmen in not striking off a useless plank from the upper door frame of the lock, and a similar omission below, but was too momentary to deserve notice. We can scarcely describe the satisfaction this trial afforded; the facility and exactness of its ascent and descent were such as to encourage several gentlemen of this city, some of whom are officially engaged in the Canal, with others who volunteered, entered the boat, and descended to the bottom of the cistern, (an immersion of 60 feet) which was particularly gratifying to the Committee, and the ingenious inventor, Mr Weldon.

The simplicity of this wonderful machine is alone sufficient to give it a decided preference to all others; but it has one property that no other can have; and that is (where the tonnage is downward) of raising for every ton of goods a ton of water, from the lower to the upper level, which in all cases is desirable, but in some so essential as not to be navigable without it".

But practical problems arose, not with the design of Weldon's machine but, with leakage of the cistern. On April 13, 1799, the Bath Herald reported that a boat could enter, descend and leave the Caisson in less than 10 minutes controlled by a boy of 12. But "The cistern which contains the Caisson is so leaky that it is impossible to continue any trials for a longer period than three or four hours at a time, arising from some deficiency in the masonry, which it is feared a new cistern alone can remedy". *(See **Buchanan, 7969, p.27-28**, for a fuller extract)*.

Most of the blame for the faulty operation of the Caisson was thus directed at the masons who built the leaking cistern *(eg. **Warner, 1801a, p. 17-18**)*. The real cause of the malfunction is more likely to have been the Lower Fullers Earth Clay in which the Cistern was excavated. This is composed of clays which have a varying ability to change volume, sometimes considerably, by absorbing. water. Wet periods would cause the clay to exert alarming pressure on the cistern walls which would bulge, destroying the critical geometry of the cistern and causing the caisson to jam in transit as in fact happened. The distorted cistern wall would be almost incapable of remaining water tight under these conditions.

Exactly similar problems befell the Sapperton Tunnel on the Thames and Severn Canal where it was similarly excavated in the Lower Fullers Earth Clay *(**Household 1969, p. 63-67**)*. This tunnel suffered severe distortion where it passed through the Fullers Earth formation. Here the distortion was first noticed in 1790, a year after the opening of the tunnel, and caused severe leakage. Household calls the defect caused by the swelling of the Fullers Earth Clays "one probably wholly unsuspected by the early engineers". Smith had however, visited the Sapperton Tunnel at least twice, in 1788 and 1794, before the Caisson was constructed and may thus have realised the cause of the troubles.

In addition one must also remember that the technology of cement and especially water resistant cement was not very advanced at this time. Ironically the Bath and West of England Agricultural Society, many of whose members were actively involved in the Somerset Coal Canal, were advertising throughout this period *(**1788-1801**)* one of their prizes "for Improvements in Mechanics" as follows: "6. Cements for Cisterns. To the person who shall invent a cheap and ' effectual composition that shall completely answer the end of foreign Terras in the cementing or lining of brick or stone cisterns so as to hold water perfectly well, either under or above ground; Plate value Five guineas". This must suggest that the Caisson Cistern mortar used was of the tarras mortar type - a mixture of slaked lime and siliceous pozzolanic earth. In 1802 this premium was no longer offered "because no reward the Society could offer would operate as any incitement". But in the Secretary's copy of the 1801 printed Rules and Orders of the Society (*Bath Univ. Lib.*) a member of the premiums committee has written ironically "Cheap and effect[ive] method already known. Omit [premium] ". This may refer to James Parkers so called Roman cement patented in June 1796 *(Hudson, **1972, p.46-48**)* which was probably too late for it to be used for the Caisson Cistern masonry.

Tarras mortar mentioned above was introduced into the British Isles by John Smeaton (1724-1792), the engineer who built the third Eddystone lighthouse from 1756 to 1759. For this he used as mortar a mixture of well burnt Blue Lias limestones from Aberthaw in South Wales and pozzolana from Civita Vecchia in Italy. Before settling on Aberthaw Blue Lias Smeaton had experimented with Blue Lias from the Bath area as a constituent of his water setting mortar. Farey *(**1811 p.114**)* recorded that this Blue Lias lime "is superior to any other that is known for Sluices, Locks, Piers and other water-works on account of its property of setting almost immediately even under sea-water and continuing to harden". He also recorded in 1815 *(p.**442**)* that this water setting or Lias lime had been long used in the vicinity of the Somerset Coal Canal, and by inference this was a practice somewhat restricted in use elsewhere, "with perfect success" in walling Coal Mines to exclude surface water and keep the mine workings there "perfectly dry . . . to vast depths beneath the surface". The special qualities of the Bath area Blue Lias limestones for this purpose were recorded by Warner *(**1801b p.396**)* and Farey tells us that they were known particularly since 1791 when Smeaton published his results with the Eddystone lighthouse. It seems therefore that one should not attribute too much blame for the Caisson's failure on the mortar used, which must surely have been of the Tarras mortar type.

Farey *(**1806, p.315**)* later reported that when the water in the cistern was drawn off to allow some alterations to be made the walls bulged so much that "the whole was rendered unsafe and useless".

Thereafter intense debate continued about the fate of the Caisson lock. At first the Committee intended to rebuild the Cistern. But on 5 June 1799, a resolution was placed

before a General Meeting to abandon the Caisson entirely for an inclined plane. This was evidently defeated and on the same day William Smith was finally dismissed. Mrs Eyles ***(1969, p. 154)*** suggested that the reason for this could have been that Smith had sided with the anti-Caisson lobby. He would have realised from his geological knowledge that the Caisson had been unsuitably sited in the [Lower] Fullers Earth and would presumably have said so. Mrs Eyles' suggestion seems an eminently sensible one.

B. PREVIOUSLY SUGGESTED SITES FOR THE CAISSON

Site 1

In an anonymous article in the Engineer, vol **107**, 1909, a writer discussed the site of the Caisson Lock following "the discovery of an old map .... lately come to light". This led him to suggest the Caisson had been sited at the end of the branch canal in Engine Wood [ie. ST 742505] and that the "bottom of the [Caisson] lift was situated either on the site of lock 10 or lock 12". The map cannot have been very reliable as the site of inclined plane "cleared of trees and undergrowth had emerged very clearly" but shown terminating quite wrongly at the west end of lock 7!

Hadfield ***(1955, pl.IX)*** also suggested that the site of the Caisson lock was probably on this branch canal leading to Engine Wood. It was this suggestion which led the BIAS excavation of 1968 to explore Engine Wood and demonstrate that the site was the remains of an engine house installed to supply the summit level of the canal with water *(Buchanan **1969**, Clew **1970, pp. 62-4, 168**)*.

Clew ***(1970, p.30)*** and Hadfield ***(1969, p.266)*** both refer to the cistern being built of brick and the discovery of brickwork in Engine Wood was one of the reasons an excavation for the Caisson was undertaken there. However, Weldon in Billingsley *(see Clew **1970, p. 165**)* says the "cistern .... .. is built of freestone". The printed June 1798 accounts for the SCC include an item "Stones quarried for new caissons" and the construction of the cistern in "Stone, mortar and other materials" is recorded in the printed report to the Canal Proprietors of December, 1799. Fuller ***(1969, p.2264)*** also said that the Caisson was sited a few yards north of the engine house. This was suggested by study of air photos and the need for a straight run into the caisson itself, rather than any documentary evidence.

If the Caisson had been sited up near Engine Wood beside Rowley Bottom, one would expect to find some evidence of the existence of the branch canal leading to Engine Wood and the Engine House at the time the Caisson was being tested. But the first reference seen to this short branch canal above todays Caisson House appears in the printed Lock Fund Report of March 1, 1806, which has an entry "New cut [after November, 1801] to place the Engine up Rowley Bottom, so as not to annoy Col. Leigh's Mansion House with smoke". Thus the branch canal to the engine house did not exist when the Caisson was being tested, and it is certainly not shown on the Smith Cary map of 1796.

Col. Leigh's Mansion House in this quotation is taken by Clew ***(1970, p.62)*** to refer to Caisson House itself. But there is evidence that Caisson House is even later. The 1810 map of the locks ***(Bath PL)*** here ***(see p. 7)*** marks on the site only "cottages" and no building here at all is shown on the Smith-Cary map. Clew ***(1970, p.76)*** says that Caisson House was V built "during the latter half of the eighteenth century for John Smith of Combe Hay. John Smith subsequently changed his name to John Leigh". However, John Smith Leigh as he became in 1806, who died on August 1, 1813 at Clifton, aged 53 *(Gents. Mag. **83 (2) p.299**)* owned also Combe Hay Manor House *(Nares **1951**)* often also referred to as his Mansion House and clearly shown on the Smith-Cary map. It must be this house which it was feared would be "annoyed with smoke" before the pumping engine was moved to Engine Wood. With the knowledge that Caisson House is later than the Caisson lock it is quite possible that at least some of the considerable Caisson cistern masonry could have been used in the construction of Caisson House as suggested by Buchanan ***(1969, p.28)***.

Site 2

Buchanan and Cossons ***(1969, p. 192)*** suggested that the site of the Caisson was probably at the "old Reservoir" marked on the 1810 manuscript map preserved in the Bath Reference Library (Figure 1). This reservoir was probably constructed for the Caisson. Sutcliffe (1800) mentioned the high water consumption of the one Caisson that was built and a reservoir of water must have been needed to work it. But there is no reason to think the Caisson would have occupied the same site as the Reservoir. Rather, common sense dictates the Caisson must have been below the Reservoir. The SCC published accounts for the year ending 1796 has an entry "Reservoir at the Caisson £156" which **may** refer to this.

Site 3

Mitchell (1874) stated "The flag-pole opposite Caisson house marks the site of the ill-fated Caisson". The site of the flag pole is shown on the Ordnance Survey map of 1884 reproduced by Hadfield ***(1955, pl.9)*** as due east of Lock 5 (see figure l). But excavations at this site have revealed nothing significant *(Clew **1970, p. 169**)*. W S Mitchell lived from 1840 to 1892, was born in Bath, and during 1869 started work on a book on the Coal Canal ***(see Eyles 1969, p. 143)*** which was never finished. He had access to the SCC minute books, but despite this and the help of the SCC Committee of the time was obviously not well informed about the Caisson from these sources *(Mitchell, **1872 and 1874**)* relying on Billingsley instead.

Site 4

Ken Clew from his detailed work on the canal's history came to the conclusion the "Caisson was near, or forms part of the pound between locks 5 and 6 in front of Caisson House". ***(letter of 73 August, 1973)***. [But he now *(Clew **1975**)* inclines to accept the evidence of the chestnut tree *(see p.8)*.] Mr A J D McArthur the owner of Caisson House agrees with this according to an article in the Bristol Evening Post of 21 November, 1972 ***(Barnes 1972)***. At the foot of the steep slope here below Caisson House, water drains away without trace and suggested a connection with the Caisson. But the 1884 OS map *(see Hadfield **1955**)* shows a fountain at the same place which may provide a further explanation of the anomalous drainage unconnected with the Caisson. Clew does show that the Caisson must have

been located within the field marked as Caisson Field (see Fig. 1) on the Manuscript plan of 1810 in the Bath Reference Library, which helps restrict considerably the possible sites which can be suggested.

C. **EVIDENCE FOR THE CAISSON'S SITE**

i. **from the SMITH-CARY MAP of 1796**

The Smith-Cary map, the relevant portion of which is reproduced by Torrens (**1974**), clearly shows the line of the Caisson as a series of broken lines in field no. 45. This map dates from late 1795 or early 1796 just when work on the Caisson was starting *(Torrens, **1975**)*. Field no. 45 can be identified as the same field as that marked a few years later as Caisson Field on the 1810 map which also shows the inclined plane. The Smith-Cary map thus shows the course of the Caisson ran to the south-west of the later inclined plane. This single piece of evidence rules out **all** previously suggested sites except Mitchell's (SITE 3), since they are all to the north-east of the inclined plane. The Smith-Cary map differs considerably from the earlier Deposited Plan (13A) of 1795 (Somerset Record Office) in this respect, which shows the canal line running farther north here.

[GREAT OOLITE LIMESTONES overlying 120 feet]

UPPER FULLERS EARTH CLAY c.40-50 ft.

with economically-exploited seam of Fullers Earth proper near top

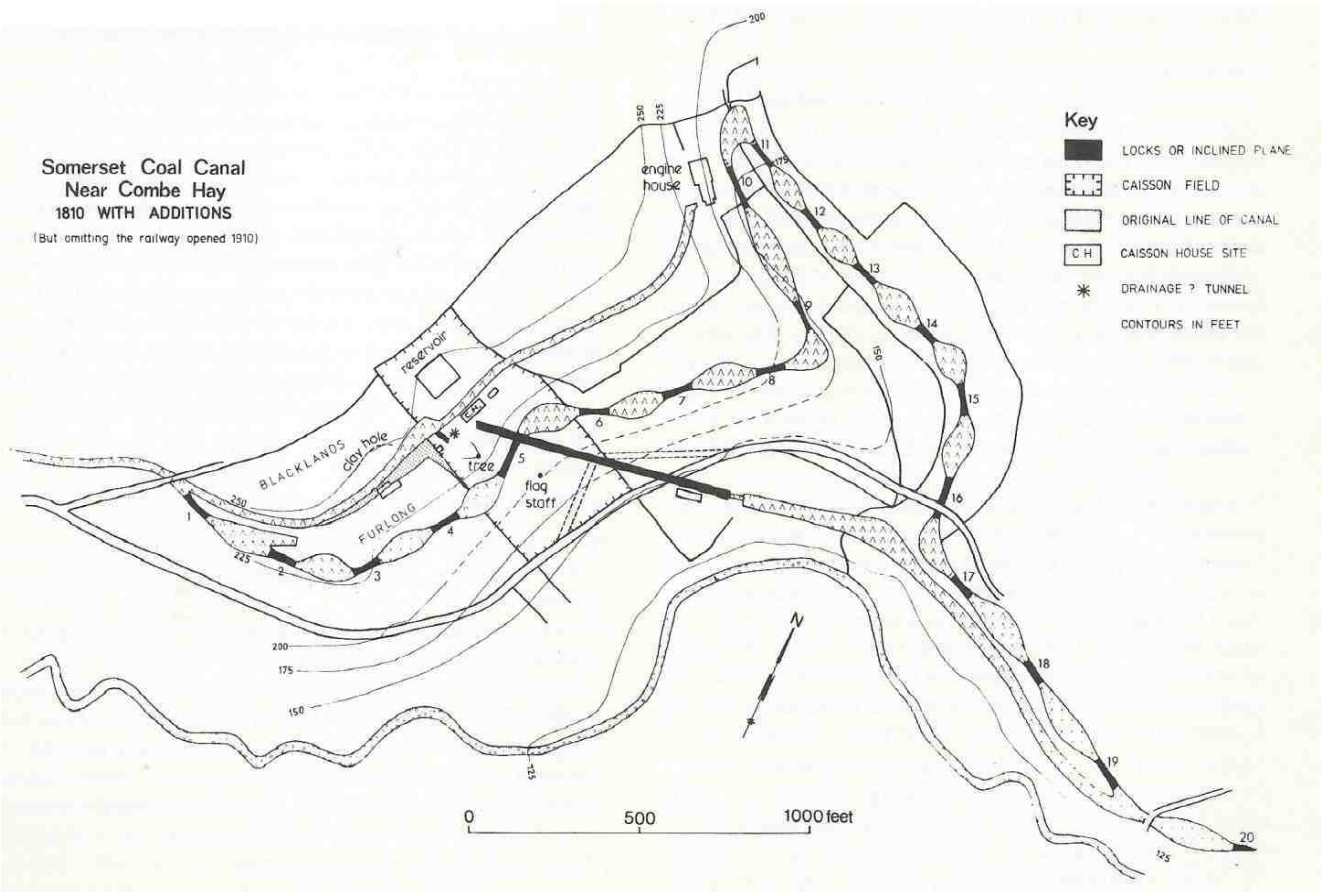
FULLERS EARTH ROCK c.10 ft.

LOWER FULLERS EARTH CLAY 40 ft.

[INFERIOR OOLITE LIMESTONES underlying]

Construction of the Caisson itself had started by the summer of 1796, and William Smith had taken an active interest in the excavations involved in order to collect fossils. Their usefulness in identifying the age of strata he had discovered less than a year previously during his work of surveying the canal ***(Eyles, 1969, p. 153)***. In his published Works Smith recorded two fossils as coming from the Caisson. These are:

a. a small fossil oyster known scientifically under the name of **Praexogyra acuminata** (J Sowerby) (Smith, 1879, p.32) - a fossil he regarded rightly as highly characteristic of the 'Fullers Earth Stratum'.



ii. Geological Evidence

The line of the canal passes from west to east through the rocks of the Triassic System up into Jurassic Rocks. Between Dunkerton and Combe Hay the canal was constructed in the limestone beds of the Inferior Oolite of the Middle Jurassic. Eastwards from Combe Hay the canal was constructed in the overlying Fullers Earth clays. The simplified geological sequence in these Fullers Earth clays near Combe Hay is from the top downwards:

b. a gastropod which he recorded but did not illustrate, under the name **Melania striata (J Sowerby)** but otherwise indeterminate from the 'Inferior Oolite Stratum' *(Smith, **1877, p.96**)* below the Fullers Earth.

The small oyster is highly characteristic of a very restricted thickness of rock in the area immediately south of Bath. It occurs within the Lower Fullers Earth clay which seems to be about 40 ft thick in the area of Combe Hay. Complete

sections here have never been described, but in a boring at Hemington 4½ miles to the south, the following sequence was discovered *(Cantrill & Pringle 1914)*.

FULLERS EARTH ROCK	15 ft
CLAY crowded with **P. acuminata**	1½ ft
LOWER FULLERS EARTH CLAY	38½ ft
INFERIOR OOLITE	39 ft

An almost identical sequence was revealed during the construction of the cuttings for the Camerton and Limpley Stoke Railway which were built in 1908-9 along the line of the Coal Canal. The Combe Hay cutting near the Caisson was described by Richardson (1910) and showed

CLAY with **P. acuminata**	c.10 ft
LOWER FULLERS EARTH CLAY	25 ft
INFERIOR OOLITE base not seen	6ft

The thickness of Lower Fullers Earth clay in the Combe Hay area is thus about 40ft with the fossil **P. acuminata** occupying a constant horizon in the top 5-10ft *(Arkell, **1933**)*.

Smith's records of fossils collected during construction of the Caisson show that it was sited in the complete thickness of the Lower Fullers Earth clay and penetrated down into an unknown thickness of Inferior Oolite beneath and perhaps some thickness of Fuller's Earth Rock above to a composite depth of c.60 ft. Smith in some manuscript notes dated about 15 August, 1797 (ie. before the Caisson had been completed) confirmed this "The bed of Bastard Fullers Earth [ie. Lower Fullers Earth] which was found in sinking the shafts and cistern for the Caisson at Combe Hay and also in the bottom of the place where the Caisson was built .... does not lay much above the under division of the Freestone or Bastard Freestone Rock [ie. Inferior Oolite] in this neighbourhood". *(Douglas & Cox, **1949, p. 183**)*.

The knowledge that the Lower Fullers Earth clay was penetrated in its entirety during the construction of the Cistern and that the exit shaft was above the Inferior Oolite allows the Caisson to be sited in terms of the geology. The strata lie in almost horizontal levels along the north and south sides of the Cam Valley, and one can place the heights up the hillside between which the Caisson cistern was constructed. Despite the problems of landslipping in the Fullers Earth in all the valleys round Bath *(Kellaway & Taylor, **1968**)* the Fullers Earth can be mapped out in this immediate area. The geology of this area is shown on the 1" sheet 281 (FROME) of the Geological Survey published 1965. The field slips on a 6" to mile scale of the officers of the Survey who mapped this area between 1956 and 1958 confirm that all of Caisson Field can be mapped geologically as solid. The landslipped zone here is above this due to the Great Oolite limestones sliding down onto the Upper Fullers Earth clay. This landslipping extends down slope somewhat more where the natural slope is greater; as at Rowley Bottom where landslipped material extends right down to the outcrop of the Inferior Oolite obscuring the whole Fullers Earth outcrop. This caused trouble when the locks were built here *(**see Clew 1970, p.60**)*.

iii. Evidence from the 1810 map

As noted above the evidence of this map (scale c.1:3000) of the Coal Canal locks near Combe Hay in 1810 is crucial. Fig. 1 is based on an accurate redrawing of it with additional information and contours. The original is in the Bath Reference Library. This map refers to ""he narrow strip of land in Blacklands Furlong [marked on figure 1 with a stipple] for the **original** line of the Canal". This must show the route of the canal before the inclined plane was built. The termination of the strip of land would be the large basin just south-west of Caisson House in which boats for the Caisson would have waited which Warner *(**1801a p. 16-18**)* recorded as all that survived of the Caisson lock by 1801. This basin is still recognizable today, though now much restricted in size. The canal was originally constructed in sections from west to east *(Eyles, **1969, p.153**)* so that the top Caisson was the only one actually completed. Its entrance door **must** have been, for it to have operated, at the summit level of the canal to the west between Paulton Basin and Combe Hay ie. about 240 ft above sea-level. But the top wall of the cistern itself would have been above this "so much higher than the upper canal as to contain a height of water just sufficient to cover the Caisson when opposite the upper level" *(**Farey 1806, p.315 quoting Chapman**)*.

The excavations undertaken by Raymond Bibby of the mysterious tunnel leading south-east from this canal basin (described by Clew **1970**) could thus be explained. The tunnel, marked with an asterisk on Fig. 1, could have been a water supply or overflow tunnel into the Caisson since it goes exactly in the right direction, but before jumping to this conclusion one must point out that John Farey *(**1806, p.393**)*, who knew William Smith well from 1801 onwards, recorded that "In several places this canal was cut through strata disposed to slip, but by the small tunnels or soughs which Mr William Smith constructed for draining of the springs, the same was prevented". This tunnel could be one of these.

iv. Other Evidence

R E M Peach, Bath bookseller and publisher of whom V J Kite *(**1966, p. 162**)* has perhaps a little unjustly said "he wrote a vast amount .... of highly inaccurate local history" produced in 1876 a new 6th edition of one of the most famous Bath guide books. This was James Tunstall's "Rambles about Bath and its neighbourhood" first published in 1847. This mentions Combe Hay "A lovely spot thou art, Combehay!" and the Caisson whose "cistern was built of freestone". The work went through 5 editions before Peach elaborately revised and rewrote it for the 6th edition published in 1876. In this *(**7th edition 1876, p. 155**)* we find some important extra information not given by Tunstall. "The situation of [the Caisson Lock] is close to the residence of Mr [William] Hill [junior] the Engineer to the Canal Company [i.e. Caisson House] and the lower end of the chamber is marked by a chestnut tree planted by Mr Hill's father [also William]. The drop was sixty feet and the walls are believed to be **still perfect as when filled up**".

William Hill senior lived from 1776 to 1868 and became engineer to the Canal Company in 1813. He had previously been involved with William Smith in mining operations *(Eyles, **1974, p. 151**)*. He would have known a good deal

about the Caisson and may have been the source of Peach's information. W S Mitchell (see SITE 3) started enquiring into the history of the Canal only in 1869 so could only rely directly on the son's information. A later (8th) edition of Tunstall's "Rambles round Bath" appeared in 1889 again revised, but by another unknown editor, but the piece about the situation of the Caisson is omitted.

v. Conclusion

From evidence in Ci. we have the Caisson lock route running beside the inclined plane, but to the south west; from Cii. we have evidence that the top of the Caisson excavation intersected this route at approximately the 240 ft contour which agrees with Ciii. which indicates the original approach to the Caisson and its basin. In the area of intersection of these lines of evidence there is indeed an artificial looking mound still crowned by a horse chestnut tree (Civ.) (above lock 5) which is the only such tree in Caisson Field. A standard work on British Trees *(Mitchell **1974, p.351**)* records that this species was introduced into the British lsles in 1616. The maximum recorded size is 38 x 6m (height x girth at a height of 5ft). Mitchell recorded that a few trees are known to be over 300 years old and in good health "but many only about 150 years old shed branches and break up". This tree has a girth of nearly 2.5m (8ft at a height of 5ft). This would at least imply an age of between 100 and 150 years. It thus appears old enough to have been planted by Mr Hill senior between 1813 and 1868 and thus to be the tree mentioned by Peach as marking the lower end of the Caisson cistern (marked as tree on Fig. 1).

The lower exit tunnel from the Caisson cistern is referred to on several occasions. Weldon reported on 6 June 1797 ***(Mitchell 1874)*** that he could not demonstrate the Caisson until the tunnel was made perfectly watertight. The description of successful trials on 17 April 1799 (***Bath Journal 22 April 1799***) makes it clear the tunnel referred to was the lower exit tunnel ***(see also Warner 1807a, p.17)***. Details of this have not been published recently, but the work involved in excavating it seems to have been some of the first started at the Caisson site. The Bath Herald for 14 November 1795 certainly advertises a meeting of the Somerset Coal Canal sub-committee on 19 November "to receive proposals and agree with any Person desirous of undertaking about 30 yards of doep (sic) cutting and driving a tunnel 30 yards in length by 13 feet high and 10½ wide to an intended Cassoon Lock, erecting in the Parish of Combe Hay and for arching and completing same. The work must be immediately begun and compleated with all possible dispatch". This shows that the exact site of the Caisson lock must have been decided by this date ***(Torrens 1975)***. The tender for construction of the canal itself from the Swan Inn to the intended Caisson was advertised a week later in the Bath Chronicle of 26 November, 1795. Statements that work on the Caisson started about 'Julv or August' 1796 may reflect lack of tenders or difficulty in completing the tunnel.

The length of the Caisson lock was 81 feet and can thus be easily accommodated between the chestnut tree and the present canal basin (which is much restricted in size) which are about 130 feet apart. The tunnel and cutting below the first Caisson lock were 180 feet in length. At this distance from the chestnut tree today is the site of the flag-pole mentioned by Mitchell (SITE 3). This has been regarded as anomalous, but one obvious explanation is that Mitchell was correctly referring to one of the Caisson sites, but **not** the one actually constructed. It has usually been assumed that only one Caisson pit was excavated because only one was needed for testing. However, Sutcliffe (**1800**) in his May estimates for completing the Dunkerton branch of the canal, has an item costed at £65 for "Sinking the Engine Pit [for a steam engine at Combe Hay between the two canal levels] 30 (word illegible), walling it where necessary and one of the Caisson pits will serve for it as far as it is sunk". This implies that a second (lower) Caisson pit was partly excavated. Certainly some of the stones for a second caisson were quarried ***(see p. 6)***. Given this the flag-pole site (no.3) must refer to the second caisson, sited below the first at exactly the correct distance. It is certain that more than one Caisson lock was projected at Combe Hay, according to Mitchell ***(1874)*** three. *(see also Hadfield 1969, p.265)* Warner ***(1801b, p.398)*** talks of the building of another cistern being suspended, again suggesting a start was made on a second.

Since the flag pole site is only about 30 feet below the summit level of the canal to the west it is important to realise that the water level at the top entrance to the second caisson will be at least 15 feet below the surface at the flag pole site. Thus it seems Mitchell's statement (SITE 3) and Peach's chestnut tree (Civ.) can be reconciled, and the two artifical mounds involved, very obvious in aerial photographs, can be explained, as can the marked divergence in line of lock 5 from the others of the series.

Only excavation will confirm these conjectures, but the close agreement between four separate lines of evidence seems compelling, and coupled with the claim that the Caisson masonry survives should be sufficient incentive for a further attempt to locate "the greatest discovery of its age".

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Postscript

Dr. Cyril BOUCHER in his book "John RENNIE 1761-1821", Manchester University Press. 1963. quotes p.125 "In 1797 Rennie reported on the Caisson Lock. and gives» an adverse opinion". l have not been able to locate this report in the Library of the Institution of Civil Engineers where most of Rennie's papers are held and it may not of course survive.

References

Anderson. J, 1796. On Canal-Locks, Bridges, Peat Moss, etc. Letters

and papers . . . . of the Society instituted at Bath for the encouragement of agriculture . . . . . **8**, 35-40.

Arkell, W J, 1933. The Jurassic System in Great Britain. Oxford Univ. Press.

Barnes, M, 1972. The Secret locked away in the hills. Bristol Evening Post. 21.11.72. p.15.

Buchanan, Fl A, 1969. Combe Hay Caisson Lock - a BIAS project report. BIAS Journal, **2**, 27-29.

Buchanan, R A and Cossons, N, 1969. The Industrial Archaeology of the Bristol Region. Newton Abbot. David & Charles.

Cantrill, T C and J Pringle, 1914. On a boring for coal at Hemington, Somerset. Summ. Prog. Geol. Sun. GB. For 1913, 98-101.

Clew, K, 1970. The Somersetshire Coal Canal and Railways. Newton Abbot. David & Charles.

Clew, K, 1975. The search for the hole in the ground - part 2. Waterways World, No 43, p.3.

Douglas, J A and L R Cox, 1949. An early list of Strata by William Smith. Geol. Mag. **86**, 180-188.

Eyles, J M, 1969. William Smith: some aspects of his life and work. in C J Schneer ed. '**Toward a History of Geology**'. M I T Press, pp. 142-158.

Eyles, J M, 1974. William Smith, Richard Trevithick and Samuel Homfray: Their Correspondence on Steam Engines 1804-1806. Tr. Newcomen. Soc. **43**, 137-161.

[Farey, J], 1806. Article headed Canal in vol. 6 of Abraham Rees Cyclopaedia 39 vols. not paginated - page numbers quoted come from the recent (1972) reprint of extracts in 6 vols. by David & Charles, Vol. **1**, pp.272-419. (Farey acknowledges writing this in 1805 in Phil. Mag. 1815, vol.**45**, p.335. It was published early in 1806).

Farey, J, 1811. General view of the agriculture and minerals of Derbyshire, vol. **1**. London: B McMillan (printed)

Farey J, 1815. On certain accidents to which coal - works are liable . . . . Phil. Mag. **45** 436-452.

Fuller, J G C M, 1969. The Industrial basis of stratigraphy: John Strachey, 1671-1743, and William Smith, 1769-1839. Bull. Amer. Ass. Petrol. Geol. **53**, 2256-2273.

Hadfield, C, 1955. The Canals of Southern England. London: Phoenix House.

Hadfield, C, 1969. The Canals of South and South East England. Newton Abbot. David & Charles.

Household, G, 1969. The Thames & Severn Canal. Newton Abbot. David & Charles.

Hudson, K, 1972. Building Materials. London: Longman.

Kellaway, G A & Taylor, J H, 1968. The Influence of Landslipping on the Development of the City of Bath, England. XXIII Int. Geol.Cong. **12**, 65-76.

King-Hele, D, 1968. The essential writings of Erasmus Darwin. London: MacGibbon & Kee.

Kite, V J, 1966. Libraries in Bath 1618-1964. Library Association thesis.

Mitchell, A F, 1974. A field guide to the trees of Britain and northern Europe. London: Collins.

Mitchell, W S, 1872. Somersetshire Coal Canal. Bath Chronicle, August 8, 1872, p.8.

Mitchell, W S, 1874. How the study of stratigraphical geology commenced near Bath. Bath Cronicle, March 26, 1874, p.7.

Nares, Gordon, 1951. Combe Hay Manor House. Country Life, **109**, 702-5, 782-5.

Richardson, L, 1910. On a Fullers Earth Section at Combe Hay, near Bath. Proc. Geol. Ass. **21**, 425-428.

Smith, W, 1817. Stratigraphical System of organised fossils. 118p. London.

Smith, W, 1819. Strata identified by Organised Fossils. Part IV. pp.25-32, 5 pls. London.

Sutcliffe, J, 1800. Report to the Proprietors of the Somersetshire Coal Canal. Bath.

Tew, D H, 1953. Canal Lifts and Inclines. Trans. Newcomen Soc. **28**, 35-58.

Torrens, H. S, 1974, Early maps of the Somersetshire Coal Canal. Cartographic J. **11**, 45-47.

Torrens, H S, 1975. Comments on Somerset Coal Canal maps. (in press). Cartographic J. **12**, 49.

Warner, R. 1801a. Excursions from Bath. Bath: R Cruttwell.

Warner, R, 1801 b. The History of Bath. Bath: R Cruttwell.

Weaver, C R, 1965. Canal Lifts. Discovery, July, p.57.