Searching for Boudica's Last Battle:

an approach via terrain analysis, hydrology and marching camps.

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Abstract

First, take Tacitus' description of the battle site - a defile facing an open plain - and as objectively as possible search the terrain of southern Britain for matching sites.

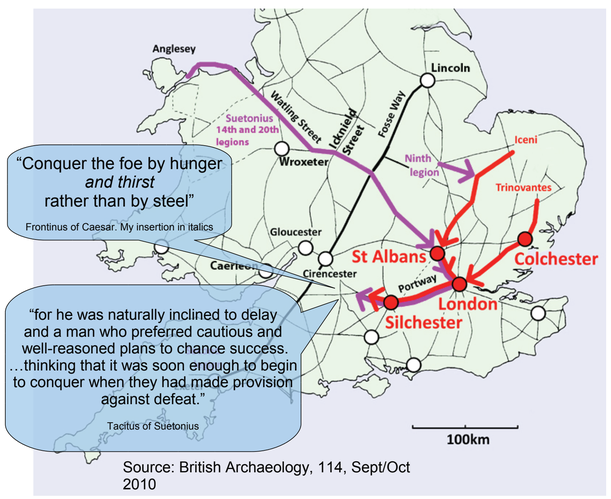
Second, compute the river flows across Britain in August; calculate the water requirements for the protagonists; use both to identify rivers capable of supplying sufficient water to the Romans and Britons.

Third, calculate topographical and hydrological descriptors for 374 known Roman marching camps in Britain and use these data to predict the location of possible marching camps.

Combining the three steps eliminates large areas unsuitable for a marching Roman army or battle ground, and identifies 110 possible battle sites.

Apply a statistical weighting to the 110 sites and then rank them.

Combining the ranked battle sites with an examination of Tacitus' account and a consideration of political and military logic, strongly suggests Suetonius, the Roman commander, marched west after leaving an indefensible London.



Source: British Archaeology, 114, Sept/Oct 2010

Finally: highly favourable areas for the siting of the battle are in the Kennet river catchment, with Ogbourne St. George at number 1, and the valleys of the Windrush and Evenlode in the high Cotswolds (Wigginton at 3, Lower Slaughter 4, and Upper Swell 6). The author presently favours the Kennet river area.

Ogbourne St. George ranked as number one of 110

Tacitus site description

Tacitus' description of the battle site in his Annals is: "He chose a position in a defile [*faux*] with a wood [*silva*] behind him. He established there could be no enemy except at his front, where there was an open plain [*aperta planities*] with no fear of ambush."

The key topographic words are defile [*faux*] and plain.

Faux is defined as:

1. the upper part of the throat, pharynx, throat, gullet;
2. [figuratively] the throat, jaws;
3. a narrow way, narrow inlet, gorge, strait, entrance, defile, pass.

Faux applies to robust topographic features, not to gentle or gracile terrain.

Terrain Analysis

The defile and plain suggests the location is similar to that found at escarpments where lower, relatively flat ground abuts ground that rises sharply. The width of the defile can be estimated from Tacitus' "close array" for the Roman force (approximately 0.5–1m per legionary), i.e. an estimated defile width of 750–1250m is reasonable.

Criteria were defined to aid the search of possible battle sites within a SRTM 90metre topographic grid:

1) a defile of approximately 1km width set within an elevated feature. The defile's sides must rise at least 30m above the bottom and have a steep slope (generally over 8°), and must extend at least 1.5km in both directions;

2) an adjacent, lower elevation, plain (less than 4° of slope) or extensive flat area with gentle slopes, at least 1km across to accommodate the British horde and wagons;

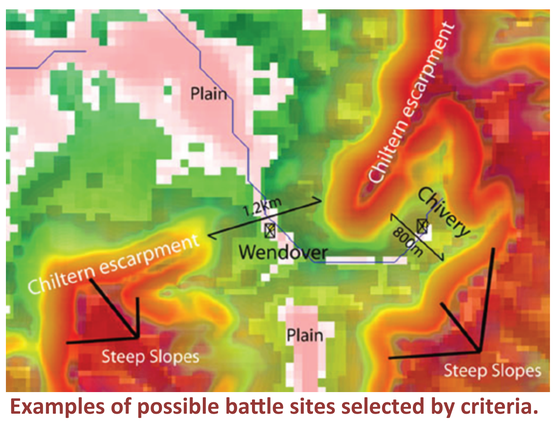
3) a gentle, positive slope (less than 5°) between the Britons and Romans;

4) the site must not be easily flanked, for example by an adjacent road or valley;

5) the site should not so intimidate the Britons that they would not offer battle but instead besiege the Romans – it must be inviting to the Britons and appear to them to be a trap for the Romans;

6) the Roman army must be able to march radially from London by road to reach the battle site's vicinity.

As a result 263 possible battle sites were selected across southern Britain.

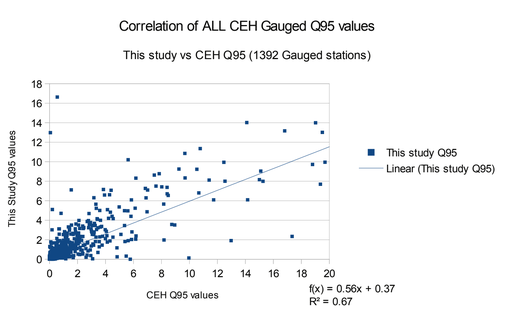


Examples of possible battle sites selected by criteria.

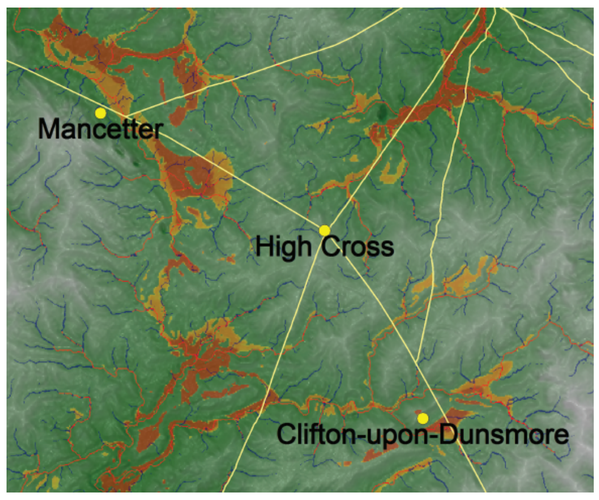
Hydrology

The hydrology of Britain was calculated for August using the SRTM topographic grid as a base.

A river flow-rate (Q95) was used to define the likely minimal supply of water from rivers. Essentially these Q95 values – calculated for the height of Summer, when rainfall, surface runoff, aquifer discharge and consequently river flows are at a minimum – tells us where the Roman and Boudican armies could march and give battle.



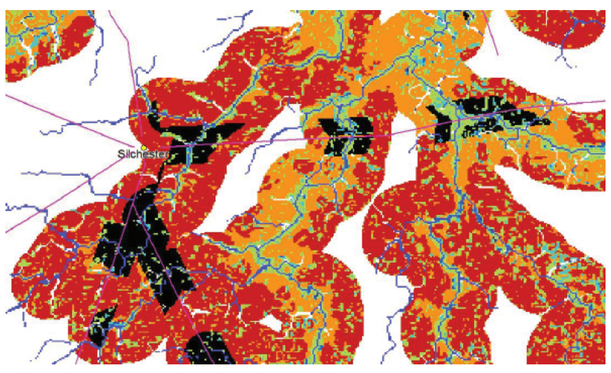
Correlation of Centre of Ecology and Hydrology data with that from this study.



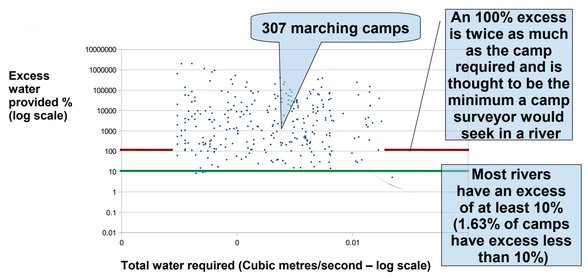
Rivers and plains overlying topography. The plains are light-dark brown; Red rivers flow at rates sufficient for the Roman army (0.0089 cubic metre second (cumec)).

Marching Camps

At the end of each day Roman armies built or reoccupied a temporary marching camp. 374 known camps in Britain were examined; topographic and hydrological attributes measured and these used to predict the likely location of unknown camps elsewhere in Britain. These findings were then applied to Suetonius' army as it retreated from London.



Possible camp sites for Suetonius' army along the Portway (London to Silchester). Coloured 'worms' are sites adjacent to rivers (red most favourable, blue least). Black areas are the most favourable sites along roads.



The total water required for 307 of the known camps plotted against the excess of water supplied by the adjacent rivers in August. Only 1.63% of camps had an excess less than 10%. It seems reasonable to suggest that Roman camp surveyors chose camp sites next to rivers that provided at least a 100% excess, i.e. twice as much as they required.

	Soldiers	Servants	Citizens	Horses	Mules
Numbers of >	10,000	2,500	2,500	937	3,000
Water/day >	9 litres/day	9 litres/day	9 litres/day	70 litres/day	30 litres/day
Unit total litres >	90,000	22,500	22,500	65,625	90,000

	Total army litres/day	Total army cubic metres/day	Minimum river flow cubic metres per second	Minimum river flow (daylight corrected)
Total for army each day >	290,625 litres	290.63 cubic metres	0.00336 cumecs	**0.00447** cumecs

Total water required by the Romans from the rivers each day is 0.00447 cumec. This is doubled to 0.0089 cumec to account for the probable river selection process by the Roman camp surveyors.

The 263 terrain analysed sites were reduced to 110 by removing those that did not supply sufficient water for the Roman army.

Weighting and Ranking

Each of the 110 possible sites has a number of attributes which can be used to apply weightings in order to remove some subjectivity (but not all) in selecting the more likely actual site:

1) the distance of the Roman camps to roads;

2) Roman tactical difficulties, for example, sites only reached by a marching U-turn; sites where rebels could control a river flowing towards the Romans, and sites more easily flanked by the rebels;

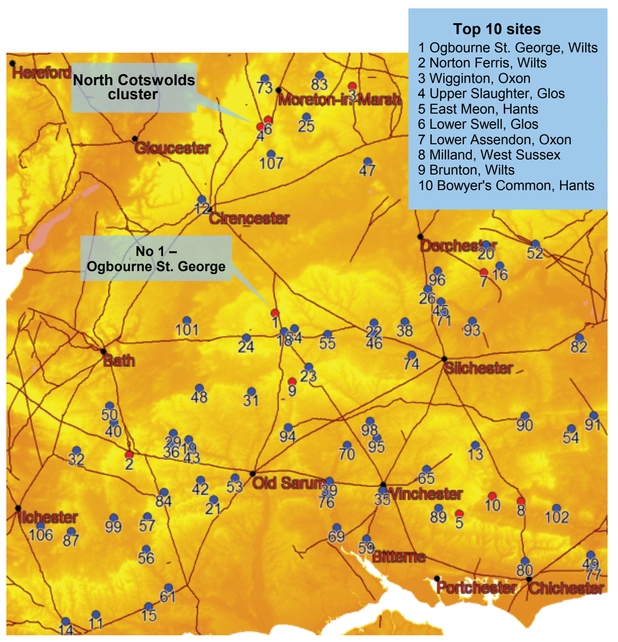
3) the distance of the nearest suitable British camp ground to the battle site;

4) a multi-attribute factor that gives a measure of rebel stress. The multiple attributes are: a) the distance to, and lack of, adequate water; b) the stress due to diminished food and fodder; c) the marching distance from London;

5) relative terrain ruggedness – this is a measure of local topography - the idea being that the most suitable site for the Romans will be the most topographically robust. This weighting was increased by 50% to represent the probable importance to Suetonius;

6) Suetonius' direction of march from London. The preferred direction is westwards.

These weighting results were ranked 1 to 110, with 1 being the more likely to be the actual battle site.



Ranked possible battle sites - 1-10 red, 11-110 blue. Ogbourne St. George in the Kennet river area is number 1. The north Cotswolds cluster has a number of very favourable sites.

Conclusion

It is postulated that Suetonius left London along the Portway, crossed the Thames at Staines, and marched on to Silchester. From there he marched westwards, taking the Ermin Street spur towards Marlborough and Bath, and into the high and dry chalk uplands of the Kennet Valley region. He may have planned the debilitating and destructive effect on the Boudican horde of marching over 116km from London to Marlborough.

The faster marching rate of the legions (29km/day) gave them four to five days at the battle site before the slower (16km/day) Boudican rebels arrived. Time enough to rest, recuperate, repair equipment, gather or consume the fodder in front of the lines and prepare the ground, water-supply and defences for either a siege or battle. Having sufficient water was critical. Unfortunately for the rebels, if they came off-the-march in a battle location without sufficient water, fodder or food, then their already strained state would be compounded.

Was Boudica destroyed by the march? A lack of water and food? And ultimately, by battle?