The Thames Story and its Ancient Plateau Gravels

This article seeks to explain a remarkable feature of the Cotswolds landscape and geology, namely why a series of gravels found across the high wolds, only contain well-rounded, far-travelled pebbles of quartzite, quartz, and volcanic rock, and no pebbles of Cotswold limestone.

The present-day North Cotswolds comprises a steep slope to the northwest of the crest of the escarpment, and a gentle dip slope to the southeast (Fig. 1). Both the scarp and dip slopes are largely composed of Jurassic limestones which are relatively resistant to erosion and hence form the pronounced Cotswolds escarpment. The steep scarp slope drains into the low-lying Vales of Evesham and Gloucester, whilst the gentle dip slope, comprising the high wolds and their deeply-incised river valleys, drains to the southeast into the River Thames.

However, the present-day River Thames and its tributaries are mere shadows of what they once were, before the Great Ice Age, and it is the above-mentioned gravels which provide a clue to the ancient history of the River Thames.

This history forms the story of the Quaternary period in the Cotswolds. The Quaternary is the youngest of the Earth's geological periods and covers the last 2.6 million years. It is characterised by major variations in climate from cold glacial periods to warm interglacial periods.

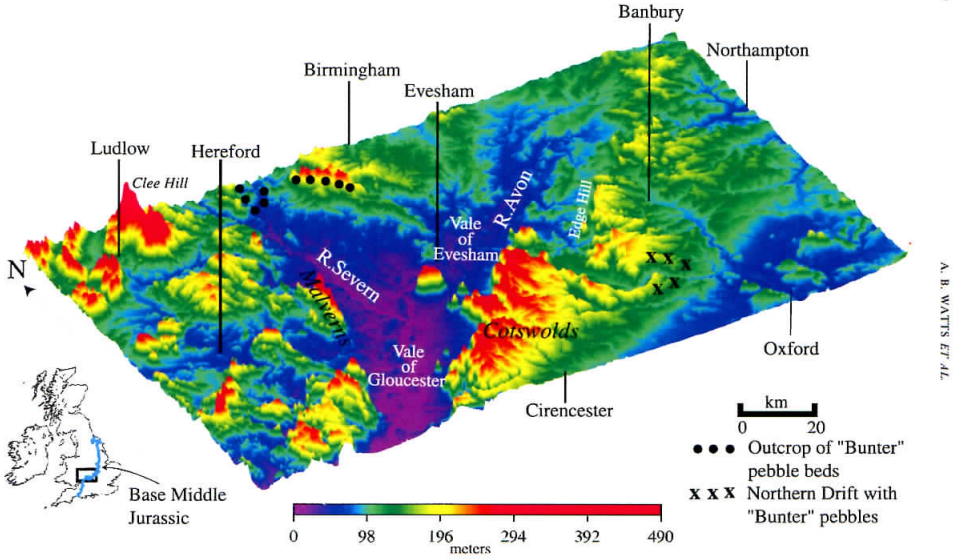

Fig. 1. Oblique view of a Digital Terrain Model of the Cotswolds and South Midlands, showing the Cotswold escarpment overlooking the Vales of Evesham and Gloucester. The crosses (x x) show the main locations of the Plateau (Northern) Drift on either side of the Evenlode valley. The black circles show the source areas of the Bunter pebbles to the west of Birmingham. (From Watts et al., 2000). The present-day course of the River Thames is shown at T.

The Cotswolds were not glaciated during the most recent cold, glacial, period (27-11,000 years ago) when the ice only came as far south as Yorkshire and the Pennines.

During the earlier, Anglian, glaciation (~450,000 years ago) the ice sheets approached much closer to the Cotswolds, and stopped roughly along what is now the line of the present Cotswold escarpment (although the escarpment was not present, or at best very subdued, at this time). Consequently, because the Cotswolds were not glaciated, any older sediments which had been deposited over the Cotswolds earlier in the Quaternary, before the Anglian ice age, should still be evident across the high wolds, albeit dissected by later river erosion.

The highest, and hence the oldest, Quaternary deposit is the Plateau Drift (also known as the Northern Drift, with 'Drift' being the term used by the Geological Survey for Quaternary surface deposits). The Plateau Drift mostly occurs as much-dissected outcrops over a broad area roughly paralleling the Evenlode River valley, from just south of Moreton-in-Marsh to the Oxford area. Elsewhere in the North Cotswolds, only scattered patches of gravel interpreted to be Plateau Drift are known (Fig. 2).

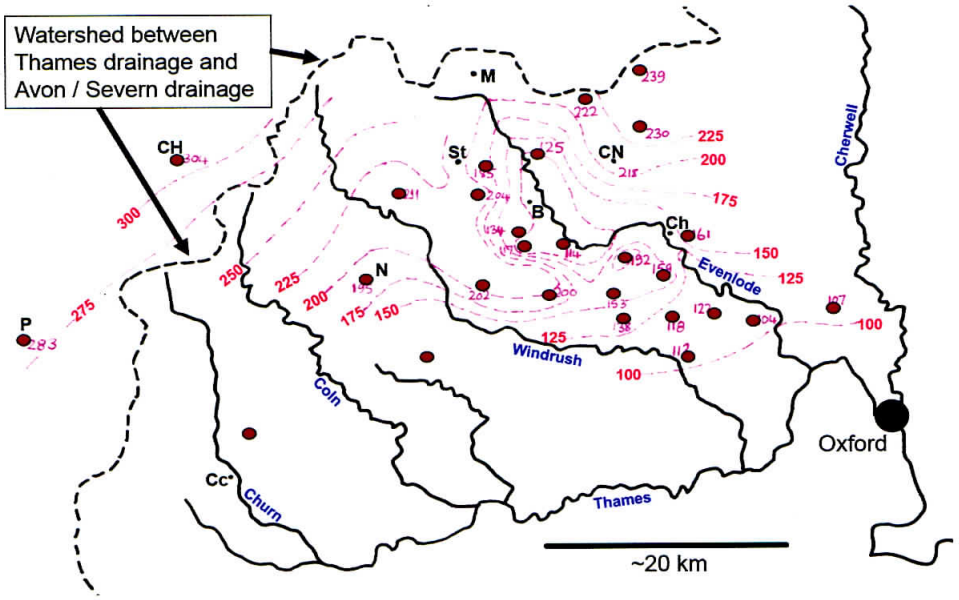

Fig. 2. Map showing the height (in metres above mean sea level) of the reported locations of the Plateau Drift gravels in the North Cotswolds (after Shotton et al., 1980). The watershed approximates the crest of the Cotswolds scarp. CN = Chipping Norton; Ch = Charlbury; M = Moreton in Marsh; St = Stow on the Wold; B = Bledington; N = Northleach; Cc = Cirencester; CH = Cleeve Hill; P = Painswick.

Plateau Drift comprises a red-brown gravel with pebbles up to 15cm (6") in length, which would have been deposited from fast-flowing braided rivers (Fig. 3). The most remarkable feature of these gravels is that (unlike younger gravels which are found at lower elevations in the present river valleys) they contain almost no limestone pebbles. Instead, these older gravels are composed of well-rounded red-brown quartzite and whitish quartz pebbles (Fig. 4), the closest source of which are the Triassic Bunter Pebble Beds of the Midlands area to the west of Birmingham. Also found in the Plateau Drift are pebbles of dark volcanic rock, some of which have been identified as coming from North Wales (Snowdonia).

Fig. 3. Braided river from the Canterbury Plains, New Zealand. Rivers of this type deposited the Plateau Drift over the Cotswolds prior to the Anglian Glaciation. (http://www.TeAra.govt.nz/en/photograph/13049)

Fig. 4. Plateau Drift gravel from Waterman's Lodge, near Charlbury. The pebbles are all of Bunter quartzite (see Fig 6. below). Notable is the absence of any pebbles of limestone. From Watts et al. (2005)

This raises the question of how did the rivers that deposited these gravels flow all the way from North Wales and the Midlands across the Cotswolds escarpment, which now rises to heights of 270-300m OD? The presence of these gravels can only mean that the Cotswolds escarpment was not present at the time, i.e. it is a relatively young feature, formed after the deposition of the Plateau Drift gravels (which have been dated as 750,000-450,000 years old), and after the Anglian ice age.

This anomaly was first recognised by Reverend Buckland in 1823, who thought the gravels were the remains of the Biblical deluge (the flood of Noah). A more convincing explanation came from W.M. Davis in 1895, who proposed that the Cotswolds tributaries of the River Thames are merely the remnants of a much larger, much more extensive, river system that reached from the southern North Sea right back into North Wales and northwest England (Fig. 5). This early Quaternary river system flowed over a low-relief, gently southeast-dipping land surface that was the result of the uplift of the north and west of Britain during the preceding Tertiary period (65 – 2.6 million years ago).

These big, high-energy, southeast-flowing rivers (akin to those now seen in, for example, New Zealand (Fig. 3)) picked up their gravels from the eroded detritus of the hills of Snowdonia and the Bunter outcrops of the Midlands, and deposited these gravels as they flowed over what is now the North Cotswolds to the sea, uninterrupted by any Cotswolds escarpment. Based on the abundance of Plateau Drift gravels along it, the Evenlode valley is thought to have been the route of the main trunk of the proto-Thames.

Then, around 450,000 years ago, the Anglian glaciers and ice sheets flowed down from the north and erased the northern parts of this Proto-Thames river system. The Cotswolds remained ice-free, but would have suffered tundra-like conditions with widespread frozen ground (permafrost). As the Anglian ice sheet began to melt and retreat northwards, there

opened up a 'corridor' parallel to the ice sheet margin down which vast quantities of melt water sought to escape: thus were formed the Severn and Avon River valleys, which both flowed south and southwest into the Severn estuary and 'beheaded' the older river valleys of the pre-Anglian Thames system (Fig. 5).

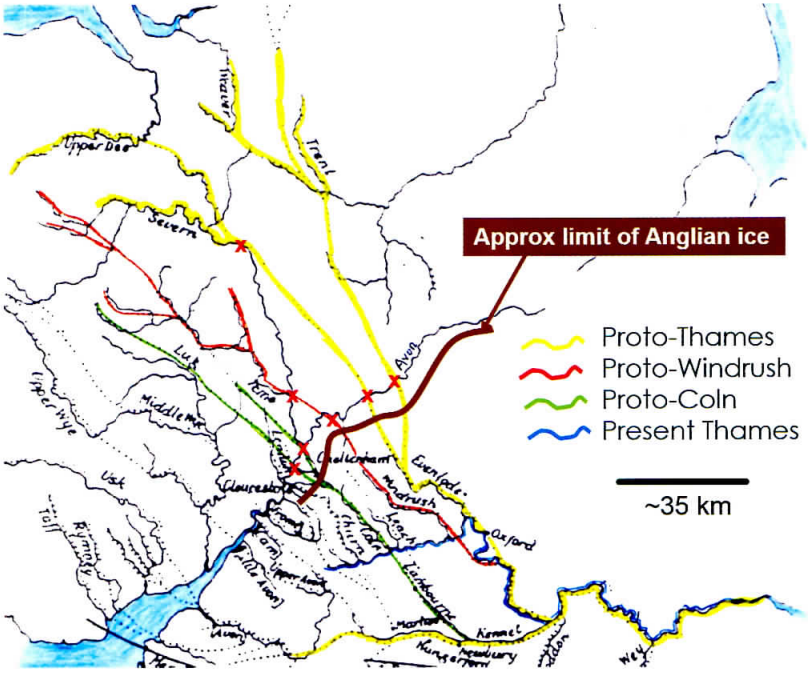

Fig. 5. Map showing the suggested courses of the Proto-Thames and other Cotswolds rivers prior to the Anglian Glaciation, which explains how the pebbles of the Plateau drift came to rest over the Cotswolds. As the Anglian ice retreated, the Rivers Avon and Severn cut back and carved out the Vales of Evesham and Gloucester. In doing so, they beheaded the Cotswolds rivers (shown by red crosses) leaving them to occupy just the dip slope of the Cotswolds. (After W.M. Davis, 1895)

The Avon and Severn preferentially eroded huge volumes of soft clays and shales from what are now the Vales of Gloucester and Evesham, and as a result of the removal of this large mass of sediment, the land surface in this area began to rise, and so the resistant limestones of the Cotswolds escarpment began to emerge, in response to this erosion of great volumes of sediment from the adjacent vales.

This concept of 'erosional unloading' is analogous to what happens when you push a rubber duck down into the bath water. When you release the duck, you are 'unloading' it, and so it rises to the surface. A similar phenomenon has occurred more recently as a result of the melting of the massive ice sheets of the last Ice Age. In Oslo Fjord, Norway, sea-level mooring rings which the Vikings used to tie up their longships a thousand years ago, are now 20 feet (6m) above sea level as a result of the rebound of the earth's crust following the melting of the ice.

After the retreat of the Anglian ice sheets; the excavation of the Vales of Evesham and Gloucester;

and the consequent rise of the Cotswolds escarpment, the Thames river system was left beheaded, with a much-reduced catchment, basically limited to the dip slope of the Cotswolds, with the River Evenlode following the course of the proto-Thames, albeit at a much lower level. The present River Thames occupies the low-lying clay vale just south of a line between Cirencester, Witney, and Oxford (see Fig. 1).

Fig. 6. Example of Bunter pebbles

A puzzling question is why the Plateau Drift is relatively well preserved on the flanks of the Evenlode valley, whilst over the high wolds to the west and southwest of the Windrush valley, only rare, scattered occurrences of the Plateau Drift gravels have been reported? Is this a reflection of a lack of knowledge of this area? Are there hitherto unreported spreads of Plateau gravel with their rounded Bunter pebbles elsewhere in the North Cotswolds, which may link to ancestral Windrush, Churn, or Coln rivers? The author would be grateful for information from any parties (farmers, walkers, etc.) who might know of occurrences of these rounded red-brown quartzite or quartz pebbles (Fig. 6) anywhere in this area. Such information could be really helpful in refining the story of the Quaternary evolution of the North Cotswolds.

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