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(incorporating the Cambs and Hunts Archaeological Society)

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Editorial

The first thing you will notice about these Proceedings is our leap (as a belated welcome to the 21st century) into colour, for our cover and a number of plates. This is not really an innovation: CAS had beautiful colour plates in 1883 and a few other 19th century volumes. At last this is affordable again, and the water colour drawings and photographs we wanted to show seemed to fully merit some extra expense. In future, we will look carefully at illustrations that would benefit from such reproduction and would be particularly keen to include fine examples of artefacts.

This volume contains some very substantial reports on archaeological work, for we are one of the few outlets available for full publication of excavations. It is refreshing to see that these all relate to recent work, not the backlogs that once were a feature of British archaeology. A quick look at the 'Fieldwork in Cambridgeshire 2003' section however reminds us what a small proportion of current work can be made available in this way. Of course, reports on all sites are produced and can be purchased from the relevant units or consulted in the county archaeological office. In future, these will also be added to a national data base known as OASIS, run by the Archaeology Data Service, so accessing this huge amount of data will eventually be much simpler. We aim to keep you abreast with such advances through our own website, *www.camantsoc.org*.

It was a great pleasure to be asked by the Cambridgeshire Local History Society to publish a short note on their superb photographic project, a worthy successor to CAS' similar project in the early party of the 20th century, now a much valued part of the Cambridgeshire Collection. This voluntary effort will likewise be used by those involved with the historic environment in years to come. The same Society asked us to include the list of recent additions to the Cambridgeshire Collection, compiled by Chris Jakes. This list used to be included in *Conduit* and has been much missed. It reminds us that our local historians are not far behind local archaeologists in their labours, a tribute to the floods of new data from an ever-active antiquarian community.

'Fieldwork', 'Reviews', 'Spring Conference report' and 'Conduit' are regular items we have managed to maintain – and which add to another substantial volume. This year, 'Conduit' was compiled at short notice by our redoubtable President, Tony Kirby, to whom we owe many thanks. In the nature of things this has to be done at the last moment, and even so many societies do not have a complete programme for the following year at the time we need it. We would therefore like to have a Supplement later in the year, as with original *Conduit*, but currently this is beyond our means. Perhaps we will have better news next year.

It remains to offer further thanks to our retiring President. Tony has taken the Society safely through two quite difficult years, and this October hands over to Nicholas James. Our Secretaries carry an even larger burden of work for the Society, of which organising nine lectures, often by speakers of national repute, is only one part. We are therefore extremely grateful to our retiring Secretary, Liz Allan, and to Janet Morris, who has now taken on the challenge. We must say a sorry farewell too to Don Fage, who has had the tough job of Registrar. It may also be noticed that we still have vacancies for Excursions Officer and for Editor of Conduit, so do contact us if you are interested in volunteering.

Alison Taylor
Editor

Cover illustration: Wandlebury, 'Lord Godolphin's house', drawn by Richard Relhan 1801

The Structure and Formation of the Wandlebury Area

Steve Boreham

Wandlebury on the southern edge of the Gog Magog Hills, is generally underlain by thin soils overlying Middle Chalk bedrock, but also includes a patch of deeper loam developed on gravelly 'superficial' deposits, mapped as 'Glacial Gravel'. Two distinct types of gravel have been identified capping the Gog Magog Hills; one rich in exotic far-travelled material, the other dominated by chalk and flint. The former is interpreted as glacial outwash of the Anglian ice sheet, whilst the latter appear to have been deposited by small local chalk streams. The position of these ancient river deposits high up on the Gog Magog Hills is explained by the inversion of relief through intense periglacial activity, which has occurred over the past 420,000 years. An appreciation of how this landscape has developed over time assists our understanding of the complex 'canvas' on which archaeological features are imposed.

Introduction

Wandlebury is situated on the southern edge of the Gog Magog Hills, some 6km southeast of central Cambridge. The Gog Magog Hills form the northern extremity of a broken ridge of higher land, including Copley Hill and Meggs Hill, that extends southeast towards Linton on the eastern side of the valley of the River Granta. The land in the vicinity of Wandlebury reaches up to a flat-topped plateau at about 75m OD. In outline, the Gog Magog Hills form a characteristic 'bird's foot' (three-toed) or trefoil form, with three low ridges of land projecting from the plateau to the west, north and northeast (Figure 1). The soils here are generally thin, chalky and well-drained, except on the plateau and ridge tops, where deeper gravelly loams occur.

Bedrock Geology

The Gog Magog Hills and Wandlebury area are principally underlain by bedrock comprising Cretaceous Middle and Lower Chalk, overlying Gault Clay at depth (Figure 1). These 100 million year-old rocks were laid down in a deep tropical ocean that covered most of what is now the British Isles. Over time, these strata have been uplifted and tilted so that today they dip gently towards the southeast. In the Wandlebury area there is some evidence for a minor disturbance or flexure in this gentle tilt. The Chalk is a soft, but exceptionally pure limestone, largely composed of the microscopic skeletal remains of foraminifera, plankton (coccoliths) and of fragments of the fossil shell *Inoceramus* (Forbes 1965). The lowest part of the Lower Chalk, the Chalk Marl, is separated from the underlying Gault Clay by a thin glauconitic marly sand, locally known as the Cambridge Greensand (Table 1). It

Table 1. *Classifications of Cretaceous bedrock underlying Wandlebury*

Former Classification *Forbes (1965)*	**Lithology**	**Thickness**	**Current Classification** *Moorlock* et al *(2003)*
Middle Chalk	White Chalk	> 30m	Holywell Nodular Chalk Formation
	Melbourn Rock	*c.* 3m	
Lower Chalk	*'plenus'* Belemnite Marls	*c.* 0.6m	Zig Zag Chalk Formation
	Grey Chalk	*c.* 30m	
	Totternhoe Stone	6m	
	Chalk Marl	*c.* 30m	West Melbury Marly Chalk Formation
	Cambridge Greensand	*c.* 0.6m	
Gault Clay		*c.* 20m	Gault Formation

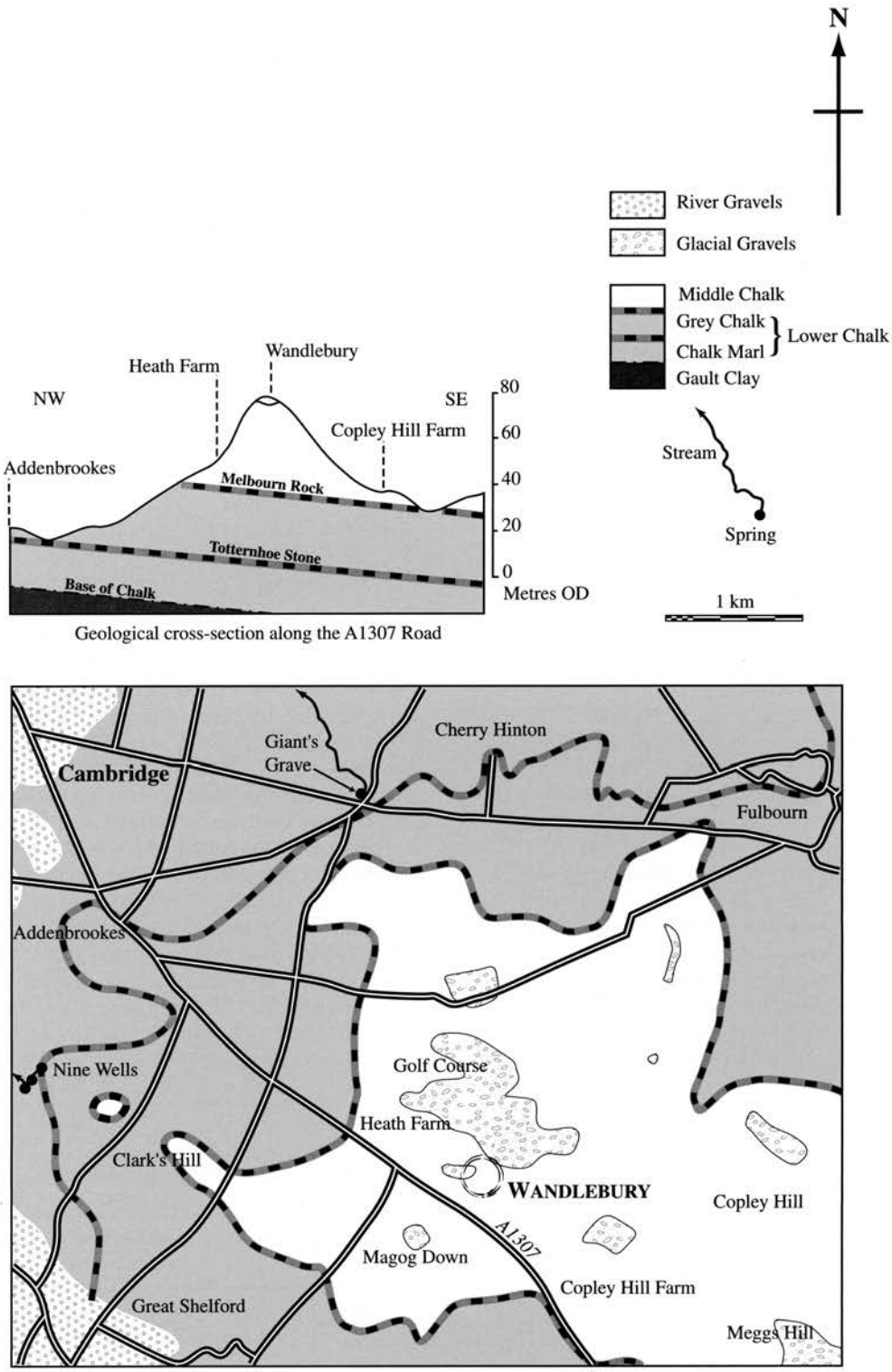

Figure 1. Geological map and cross-section of the Gog Magog Hills and Wandlebury showing the outcrop of Cretaceous bedrock and Quaternary deposits.
Geology reproduced by kind permission of the British Geological Survey. Based upon the BGS Geological Map Sheet 205, Saffron Walden: 1:50 000. IPR/52-57C British Geological Survey. (c) NERC. All rights reserved.
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is from this bed that phosphatic nodules, or coprolites were extracted by open-cast mining in the Cambridge District during the later parts of the 19th century. The upper part of the Lower Chalk, the Grey Chalk or 'Clunch' is separated from the Chalk Marl by a hard and fissured band known as the Totternhoe Stone or Burwell Rock. It is from this stratum that many of the springs in the local area, for example those at Nine Wells, Great Shelford, and at the 'Giant's Grave', Cherry Hinton, arise. The overlying Middle Chalk is marked by another hard band, the Melbourn Rock, underlain by the characteristic fossil belemnite *Actinocamax plenus*, which gives its name to the thin *'plenus'* Marls, which outcrop on the upper slopes of the Gog Magog Hills. The Middle Chalk is also characterised by the first appearance of flints, which take the form of small globular and pear-shaped nodules. Many of these divisions of the Chalk have been superseded in recent times by formal lithostratigraphic units, which for the curious are described in Moorlock *et al.* (2003) (see Table 1).

Quaternary Deposits

The flattened summit of the Gog Magog Hills, onto which the Wandlebury enclosure encroaches, is capped by a deposit of gravel and sand, mapped as 'Glacial Gravel' by the British Geological Survey (BGS). These 'superficial' or Quaternary drift deposits were well known even at the end of the 19th Century. Osborne White (1932) writing in the Saffron Walden Geological Memoir states "The chief deposit is that of Vandlebury and the Golf Course. On and around the Golf Course exposures of sandy gravel exist in many places. The best of those seen by the writer is in a pit sunk in the flat ground about a furlong (220m) west of the northern angle of the Vandlebury enclosure. Here are shown some 14ft (4.6m) of lenticular, current-bedded gravel, sand and loam, covered and piped by red-brown clayey loam with seams of small stones (mostly angular flint)." This account presents compelling evidence that the gravelly material near Wandlebury was deposited by flowing water, probably a stream or river. However, White (1932) provides further evidence for the provenance of these deposits. "The gravel is among the coarsest in the district, the boulders of Chalk, Lincolnshire tabular flint, septaria, and sandstones ranging up to 1½ ft (45cm) in diameter. Red Chalk is common; Jurassic material and far-travelled silicaceous rock are abundant."

These observations are very similar to those made by the author from sections at the top of Clarke's Hill, Great Shelford (Boreham 2002). At this location a unit of chaotically bedded cobbles was overlain by at least 1m of fine-grade current-bedded chalky gravel. The cobbles were generally about 13cm in diameter, although some reached 28cm across. In contrast, the pebbles in the overlying gravel rarely exceeded 1cm in diameter and were mostly rounded chalk. Only 12% of the cobbles were composed of chalk or flint, and almost 40% were Jurassic limestones and grits. In addition, nearly 30% of the cobbles were Millstone Grit or Carboniferous Limestone originating from the Pennines, and 20% were metamorphic rocks such as quartzite and schist or igneous rocks like dolerite from the Whin Sill, in Northumberland. It is clear that very high energies would be required to transport cobbles of this size, and the fact that almost 50% of the cobbles were of far-travelled exotic lithologies, strongly suggests their transport by ice to the Cambridge District. The most extensive glaciation of southern England is widely accepted to have occurred during the Anglian Stage, some 450,000 years ago. These ice sheets brought a thick mantle of 'Chalky Boulder Clay' or till to the surrounding area. It is to this glacial event that the exotic cobble deposits of the Gog Magog Hills and Wandlebury area are attributed.

In contrast to these deposits, on the top of Magog Down (once known as Little Trees Hill) the author described current-bedded gravel and sand, dominated (>60%) by rounded chalk pebbles up to 3cm diameter, down to at least 1m below the surface. The fine-grade chalky gravel resting on the exotic cobbles at Clarke's Hill was almost identical in character to this, and similar chalky gravels have also been observed by the author at several locations on the plateau close to Wandlebury. Given that chalk is rather soft compared to flint, and is considered a non-durable component of river gravels, these chalk pebbles could not have travelled very far from their source. Indeed these deposits are very similar in character to those of a much younger age flooring dry valleys developed on the Middle Chalk at Therfield Heath, Royston. The position of some chalky gravels overlying the Anglian exotic cobbles mean that they are of Anglian or younger age. However, due to the lack of exposures, it is impossible to determine the exact stratigraphic relationship of all the known examples of chalky gravels and it is likely that some may underlie the cobbles and thus pre-date the advance of the Anglian ice. All that can be said is that the chalky gravels represent deposition in a particular environment.

It therefore seems clear that the 'Glacial Gravel' mapped by the BGS comprises at least two distinct types of gravelly deposit associated with the Gog Magog Hills and Wandlebury area. The first is a coarse-grade cobble gravel full of exotic lithologies from far-travelled sources, brought to the area by Anglian ice sheets. The second is a fine-grade gravel characterised by rounded locally derived chalk pebbles, deposited by local streams draining chalk hills.

Formation of the Wandlebury Area

There is little direct evidence to assist with palaeoenvironmental reconstructions from the Wandlebury area in pre-Anglian times. Most of what can be said relies upon evidence from areas adjacent to the Cambridge District. It appears that during the early Middle Pleistocene (more than 500 thousand years ago), the Chalk escarpment was a more striking feature of the landscape, and may have outcropped some

10km to the northwest of its current position (Clayton 2000) and reached to *c.*120m O.D. It is also clear that much of Fenland would have been at a considerably higher elevation (up to 60m O.D.) than today. Within the Cambridge District, only deposits beneath the Anglian till, and perhaps some of the chalky gravels of the Wandlebury area have the potential to be of this age. The chalky gravels may in part represent high-level headwater deposits from streams draining southeast from the edge of the Chalk escarpment.

The approach of the Anglian ice sheet appears to have been preceded by copious glacial outwash. There is some evidence for oscillations during this glacial advance from a till and outwash complex in the upper Cam valley (Baker 1977). During this period, ice lodged against the Chalk escarpment, and outwash streams followed the courses of headwater valleys draining towards the southeast. This outwash is represented by the exotic cobble deposits of the Wandlebury area. There is also evidence from the upper Cam valley that large pro-glacial meltwater lakes formed at this time in front of the advancing ice. Once ice overrode the Chalk escarpment, till was laid down in a thick mantle behind the escarpment edge. Along the main north-south Cam valley, a deep 'tunnel' valley was carved into the bedrock by sub-glacial drainage. Similar features are known from Stevenage, Hertfordshire, and from elsewhere in East Anglia. This incisional feature was subsequently filled by till, glacio-lacustrine and outwash sediments. The buried channel containing these glacial sediments can be traced in the Cam valley at Whittlesford Station and at Girton (Boreham 2002).

Following the Anglian glaciation, chalky gravels were deposited by streams flowing toward the southeast. Their presence suggests that the chalk escarpment partly survived being overridden by the Anglian ice. Today these deposits cap areas of high relief, but were originally deposited in stream valleys. For this inversion of relief to have occurred, there must have been major landscape change during the 420,000 years since the end of the Anglian Stage. Chalk bedrock is particularly susceptible to solution and erosion during periglacial climatic conditions. The period since the Anglian is characterised by cold or glacial conditions, punctuated roughly every 100,000 years by shorter warm or interglacial periods, each lasting around 10,000 years. The present-day Holocene interglacial does not represent the harsh climate that has prevailed during the past 420,000 years. Even a 1mm loss of height per decade on Chalk bedrock under intense periglacial conditions would produce a 40m loss in height over this timescale. The presence of deposits such as river gravels appears to armour the Chalk bedrock, and prevents or slows considerably erosive processes. Over time this armouring effect causes gravels once deposited on the valley floor to become resistant hill cappings. A useful adage to summarise this phenomenon is "the hills of today are the valleys of the past". Thus, the three-toed ridge morphology of the Gog Magog Hills can be interpreted as three tributary valleys draining southeast from a chalk escarpment, and uniting with a common confluence at Wandlebury, before continuing to flow southeast following the regional dip of the Chalk bedrock.

Conclusions

It is clear that whilst the Gog Magog Hills are primarily outcrops of bedrock chalk, they owe their existence, at least in part, to a capping of resistant gravel. This gravel is not a single deposit, and comprises two distinct lithologies, the stratigraphy of which is not always clear. Indeed, the very form of the hills has been determined by the original mode of deposition of this gravel in chalk-sided valleys draining towards the southeast from an ancient escarpment; the opposite direction to the present river drainage. The high ground that gave rise to these valleys has long since been eroded by millennia of intense periglacial activity, leaving a skeletal tracery of an ancient river system, in the form of the hills we see today. It is upon this landscape that humans have imposed out of practical necessity and ceremonial significance the archaeological features that we currently observe.

Acknowledgements

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