Ancient Monuments Laboratory
Report 127/87

ARCHAEOMAGNETIC DATING: SWAN LANE, CITY OF LONDON, 1981.

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Summary

A sequence of six superimposed pitched tile hearths excavated on the medieval London waterfront were sampled for archaeomagnetic dating. Although the results were magnetically good, only the lowest hearth seemed to be physically stable enough to produce a convincing date of early to mid-thirteenth century. This was in reasonable agreement with a date of 1178 or slightly later for a supporting timber frame.

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Introduction

The Swan Lane site consisted of a single trench cut into the basement floor of a multi-storey car park prior to its redevelopment. The trench revealed part of the medieval waterfront build-up, which included a sequence of six superimposed pitched tile hearths. These were well built and walled with stone, with a single flue, the lowest resting on a stout timber frame.

The development of the directional archaeomagnetic dating reference curve can be much helped by measurements on superimposed sequences of hearths, which in good conditions give valuable information about the shape of the relevant length of the curve. However, the prolonged occupation associated with such sequences often creates deep accumulations of made soil which give rise to problems of physical instability that upset the directional magnetic record.

At Swan Lane, the instability problem threatened to be particularly serious because the whole waterfront development process depended upon the building up of the ground with dumped material, but the potential usefulness of this sequence of six hearths, with dating comparison provided by dendrochronology, could not be ignored. Although such hearths are built from roofing tiles, with thermoremanent magnetisation fixed in them when first fired, and unrelated to their positions in the hearths, it is found that the magnetisation of at least 1 cm of the top edge of each tile is normally reorientated by the heat of the hearth.

The site provided a challenge for the archaeomagnetic sampling techniques developed by the Ancient Monuments Laboratory and the Department of Geophysics and Planetery Physics, University of Newcastle upon Tyne. The extreme wetness of the material was a severe test for the adhesion of the epoxy resin used to attach the small plastic reference discs to the samples: this was greatly helped by using a masonry cutting disc in a portable electric drill to make keying grooves, which were also ideal for relocating the set adhesive on the tiles if they did become detached during removal; thus no samples were lost in the latter part of the operation, which had to be carried out on a succession of visits as the hearths were exposed.

Sample orientation was also extremely difficult. A magnetic compass could not be used because of interference from the steel shuttering of the trench and the building structure, and sun shots were impossible in this situation. Initially, therefore, orientation was related to the building support columns, and an approximate north obtained from the architect's plan. The difficulties of this site provided the impetus for the purchase by the AM Laboratory of a Wild gyro theodolite which obtains the true north direction by interaction with the rotation of the

Earth, and is thus effective in any stable situation. With this, the precise orientation of the reference line provided by the columns was obtained. Following standard practice, a number of samples (usable samples ranged in number from 7 to 12, except as noted in the case of the first hearth) were taken from the parts of each hearth that seemed stable, in order to obtain a statistical mean. Laboratory measurements were made in a Digico spinner magnetometer.

Results

The results given below are the mean thermoremanent directions for each hearth, after removal, if necessary, of viscous magnetism acquired since firing by partial demagnetisation in an alternating field. Alpha-95 is a measure of the precision of the mean magnetic direction. The stability, shown in brackets, is a subjective estimate, on a scale A-D, of the physical stability of the structure since firing. The full data for each set of measurements will be published in definitive lists elsewhere; but the basic data given here in heavy type, and preferably any other comments in the entry for each hearth, should be published in the site report to increase the accessibility of the results to those interested technically. It is essential that the AML numbers are quoted.

The first hearth is the lowest of the series - the last to be sampled.

First hearth, Context 329. This hearth was heavily grouted with clay which produced 6 usable samples; results from 5 samples from the tile were too scattered.
AML-868343. Dec = 11.3^{o}E; Inc = 57.4^{o}; alpha-95 = 2.6^{o} (stability B).

Second hearth, Context 298.
AML-868344. Dec = 14.2^{o}E; Inc = 62.7^{o}; alpha-95 = 2.2^{o} (stability C).

Third hearth, Context 300.
AML-868345. Dec = 16.0^{o}E; Inc = 61.5^{o}; alpha-95 = 2.0^{o} (stability C).

Fourth hearth, Context 286.
AML-868346. Dec = 1.1^{o}E; Inc = 59.2^{o}; alpha-95 = 12.8^{o} (stability C).

Fifth hearth, Context 206.
AML-868347. Dec = 26.2^{o}E; Inc = 62.3^{o}; alpha-95 = 2.5^{o} (stability C).

Sixth hearth, Context 205.
AML-868348. Dec = 22.7^{o}E; Inc = 64.3^{o}; alpha-95 = 2.4^{o} (stability C).

Interpretation

When plotted on the reference curve, these results, taken at face value, show a trend of increasing age, from the thirteenth century to about 1100, as the hearths become younger! This can be explained as due to an an increasing tendency for the hearths to slump, rotating on the soft clay layers separating them in a rather complex manner about a roughly north-east to southwest axis. There was some visible evidence of this: in hearth 298, for instance, it seems to have taken the form of a south-easterly downward tilt during the use of the hearth, partially corrected later by the weight of the later hearths. The slumping problem may partly explain the frequent rebuildings.

The first hearth, 329, firmly based on its wooden frame (Context 385B), seems to have been the most stable, giving an archaeomagnetic date of early-mid thirteenth century for the last firing. Although in the circumstances this result cannot be regarded as highly reliable, it compares reasonably with a dendrochronological date of 1178 or slightly later for the frame timber (Groves and Hillam, 1987), which need not have been new when used. Also, the earlier dates suggested by other hearths are not compatible with the associated pottery. It must be conceded that the Swan Lane hearths contributed little to the development of the archaeomagnetic curve, but considerably to our appreciation of the problems of sampling and interpretation in adverse conditions.

Reference

Groves, C., and Hillam, J., 1987. Tree-ring analysis of timbers from Swan Lane, City of London, 1981. Ancient Monuments Laboratory Report No. 30/87