

FISHBOURNE HYPOCAUST

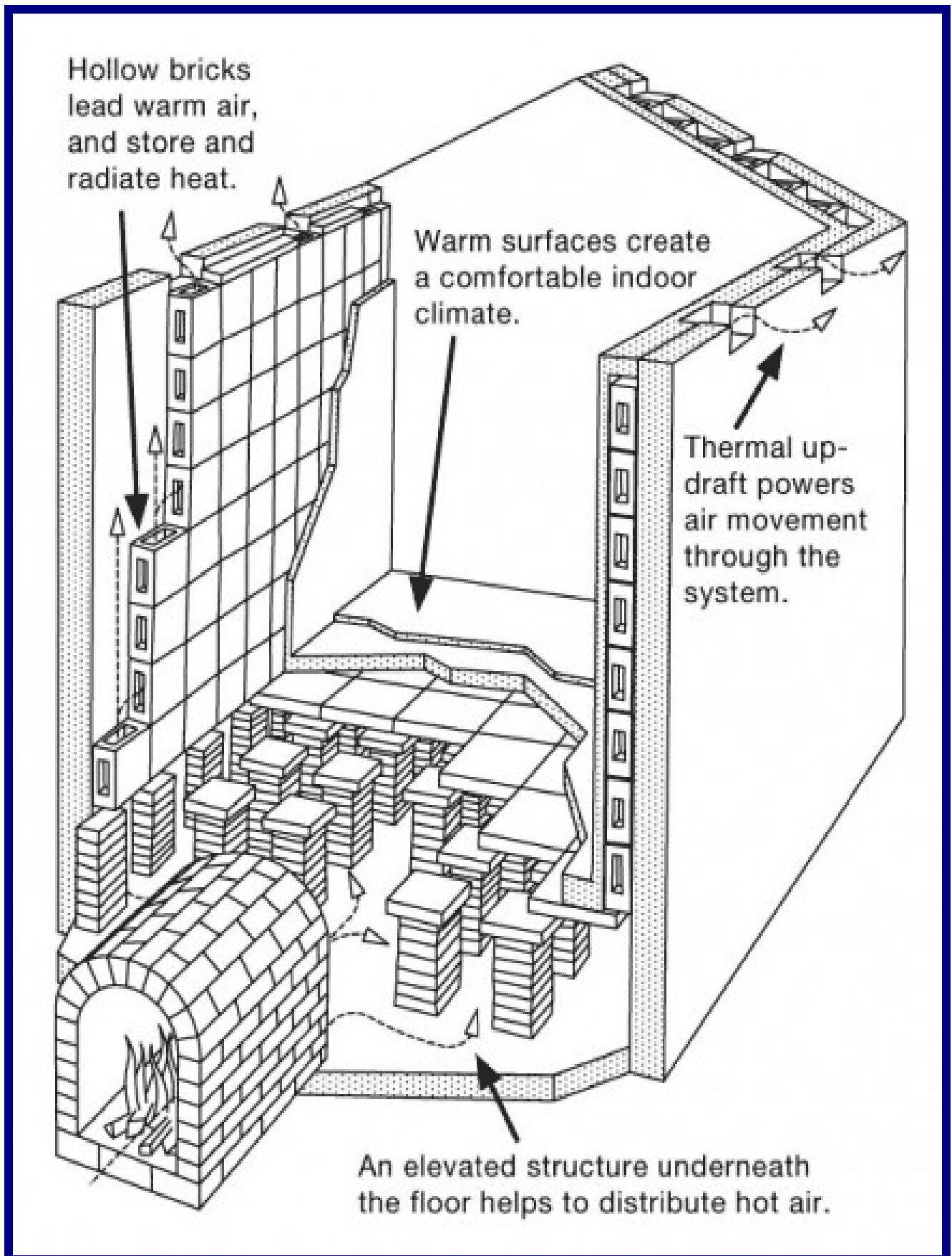


HEATING HISTORY

THE HYPOCAUST PART ONE

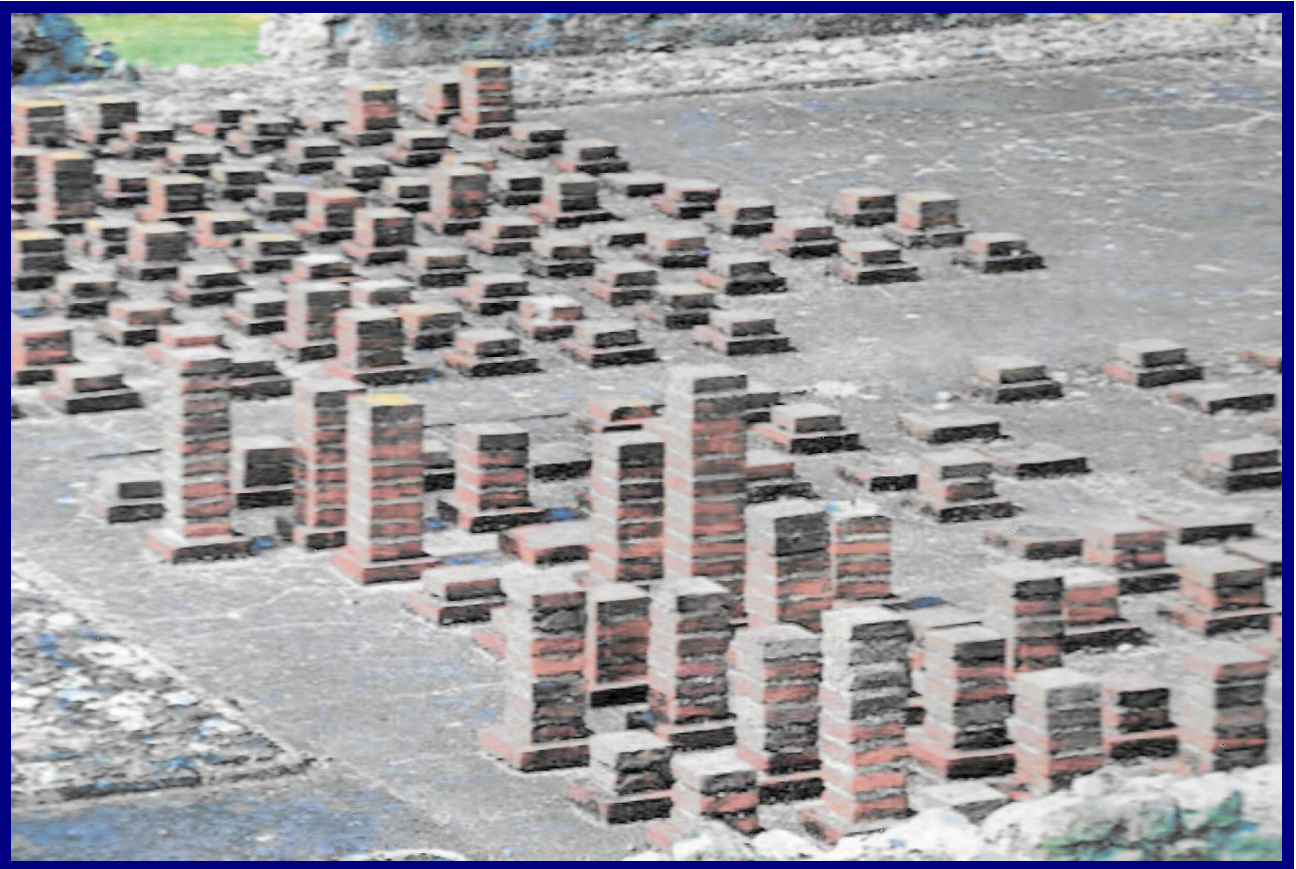
BRIAN ROBERTS

THE HYPOCAUST HEATING SYSTEM



<3>

WROXETER HYPOCAUST



THE HYPOCAUST PART ONE

PAGE INDEX

Britain: 1,3

Hypocaust System: 2,4-5

UK Examples: 6-17

Feature: Exeter Hypocausts: 18-23

Overseas Examples: 24-30

References: 30

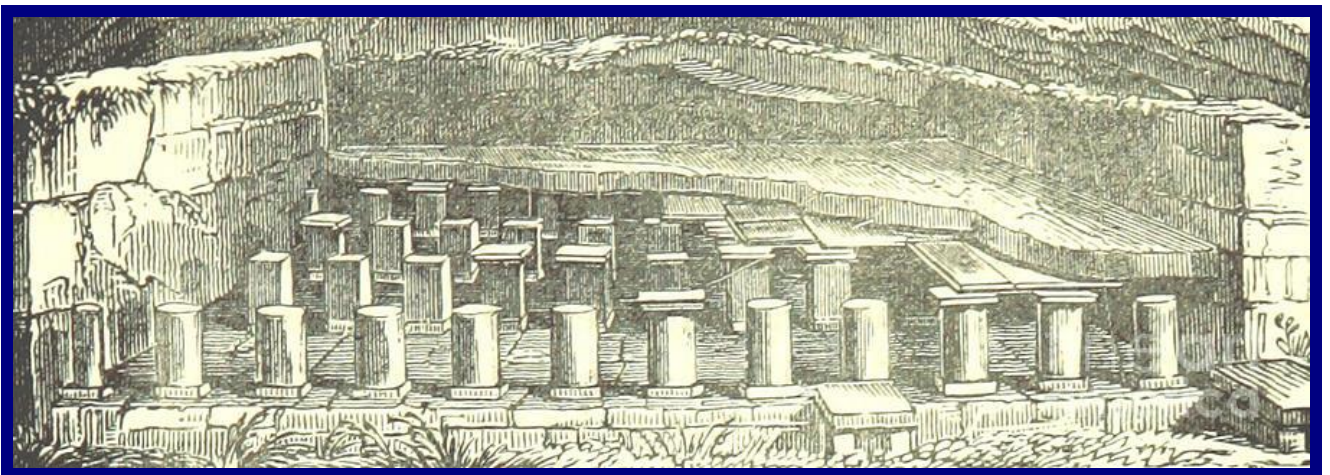
THE HYPOCAUST HEATING SYSTEM

The **Hypocaust** is a system providing central heating in a building. It works by heating the air in a solid-fuel furnace and circulating this warm air below the floor of the room or bath. One reference suggests that the Greek Temple at Ephesus was heated in this way in around 350 BC, but the Roman writer Vitruvius attributes the invention of the hypocaust to Sergius Orata around 80 BC.

The Roman furnace, or stoke hole, was fed with wood as fuel by a slave or attendant. Hot air and smoke from the furnace would circulate through this below-floor space, the hypocaust, the ceiling of which was raised above the ground by pillars (**pilae stacks**). These supported a layer of tiles, followed by a layer of concrete, then the floor tiles of the rooms above. Hot air and smoke from the furnace would circulate through this enclosed space and then up through clay or tile flues in the walls of the rooms above to outlets in the roof. This arrangement could also be used to warm upper rooms. Rooms intended to be the warmest were located nearest to the furnace below.

Heat output was regulated by adjusting the quantity of wood fed to the fire. This was a labour-intensive and time-consuming operation, requiring constant attention and large amounts of wood as fuel, making the hypocaust found only in public baths and large villas.

The remains of numerous Roman hypocausts have been found throughout England, continental Europe and as far afield as northern Africa and western Asia. After the decline of the Roman Empire, various forms of hypocaust were developed and survived for many centuries.



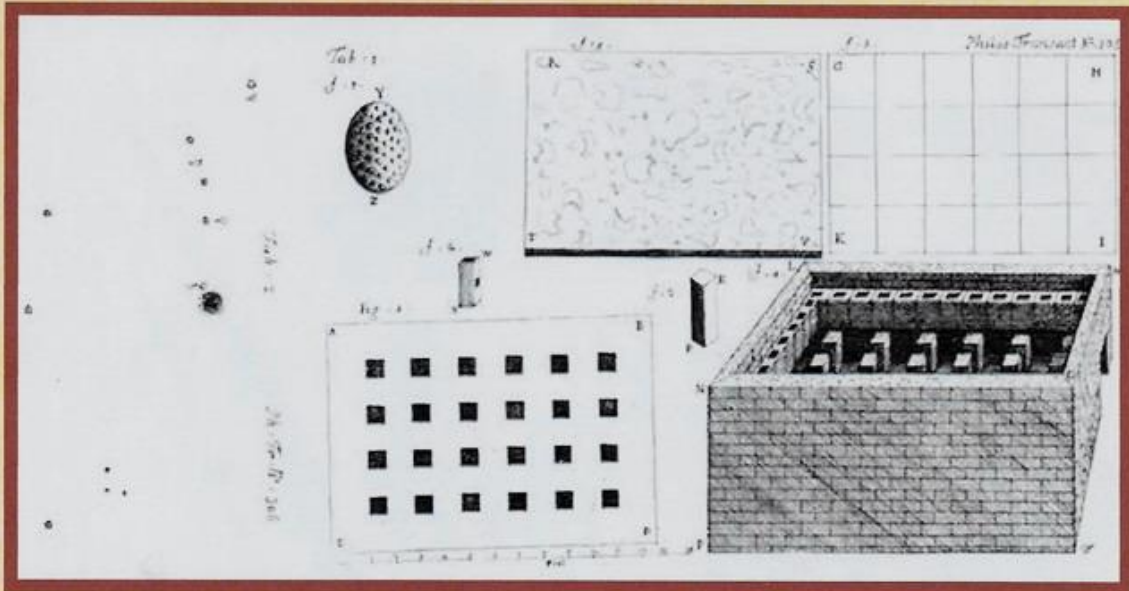
Remains of a hypocaust at Lincoln.

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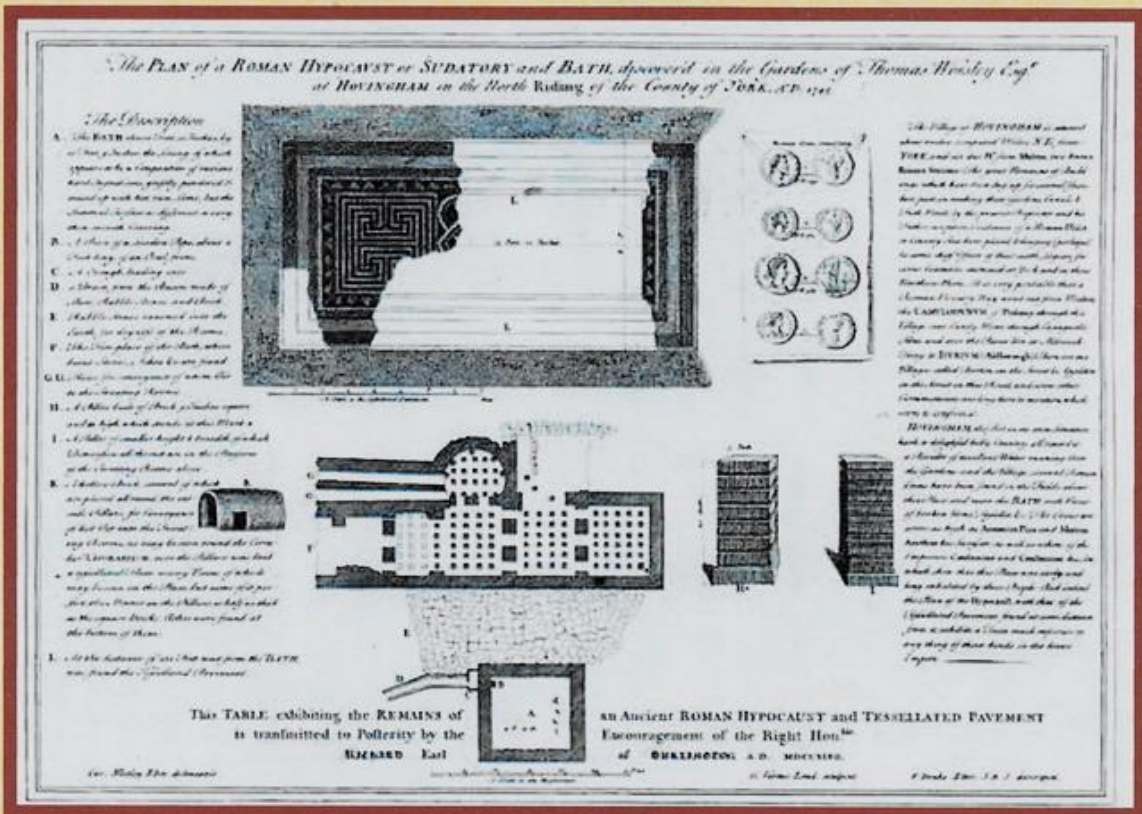
HYPOCAUST WALL FLUES



WROXETER & HOVINGHAM HYPOCAUSTS

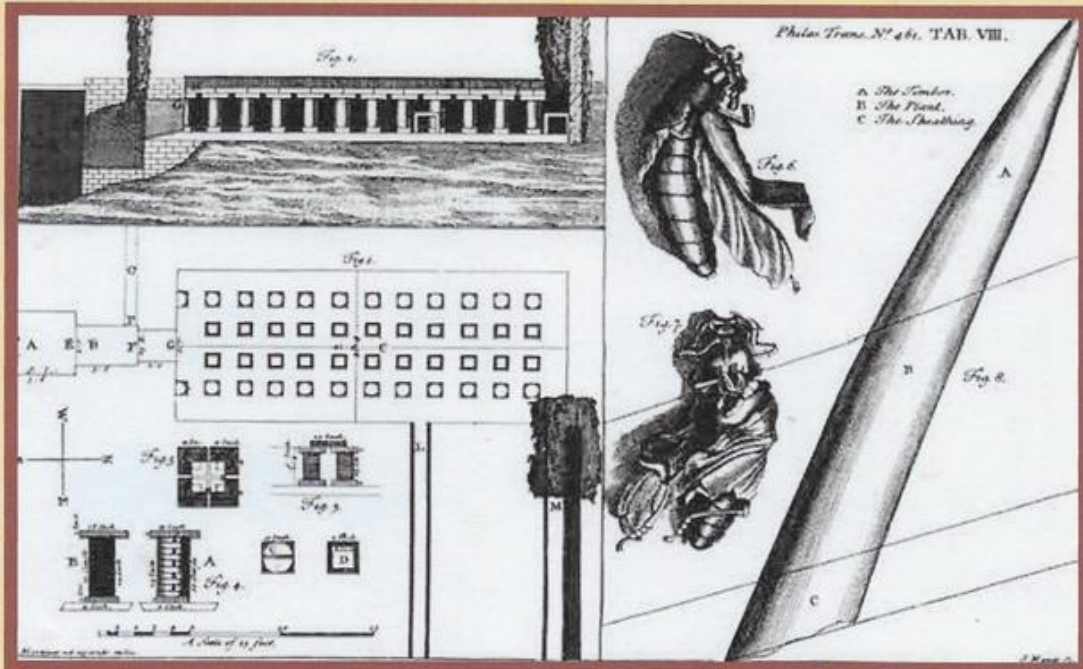


Hypocaust found 1701 at Wroxeter, *Philosophical Trans Royal Society Vol.25, 1706*

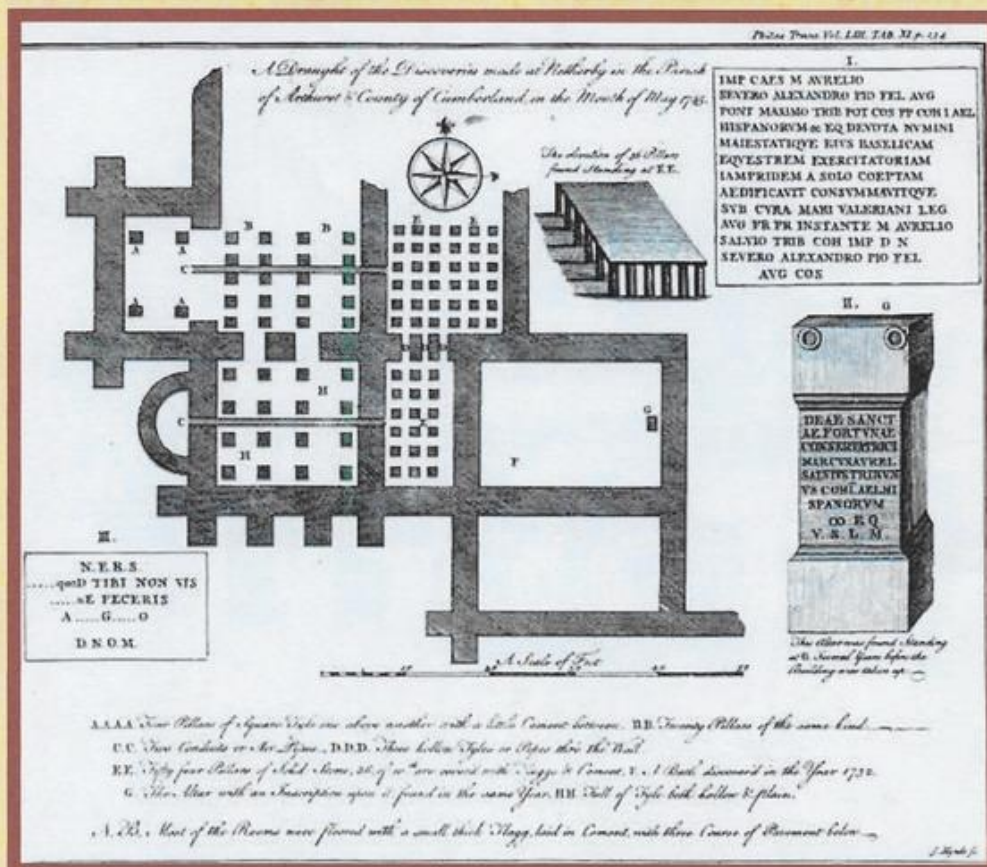


Hypocaust at Hovingham in 1745, *British Museum*

LINCOLN & NETHERBY HYPOCAUSTS

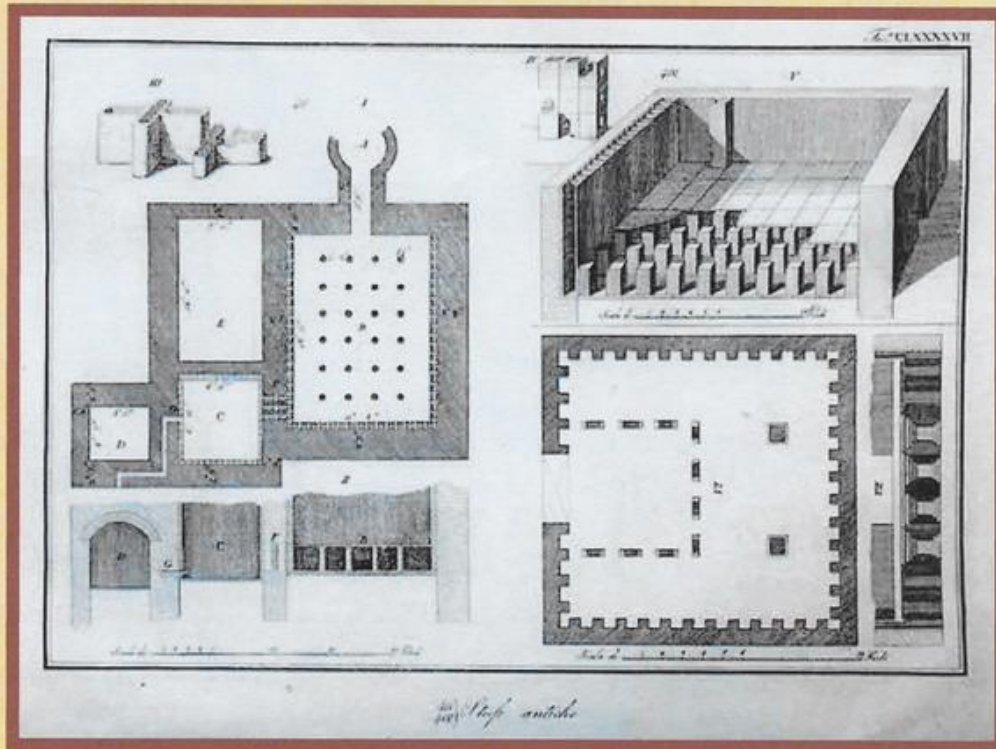


Lincoln 1739, *Phil Trans* Vol.41

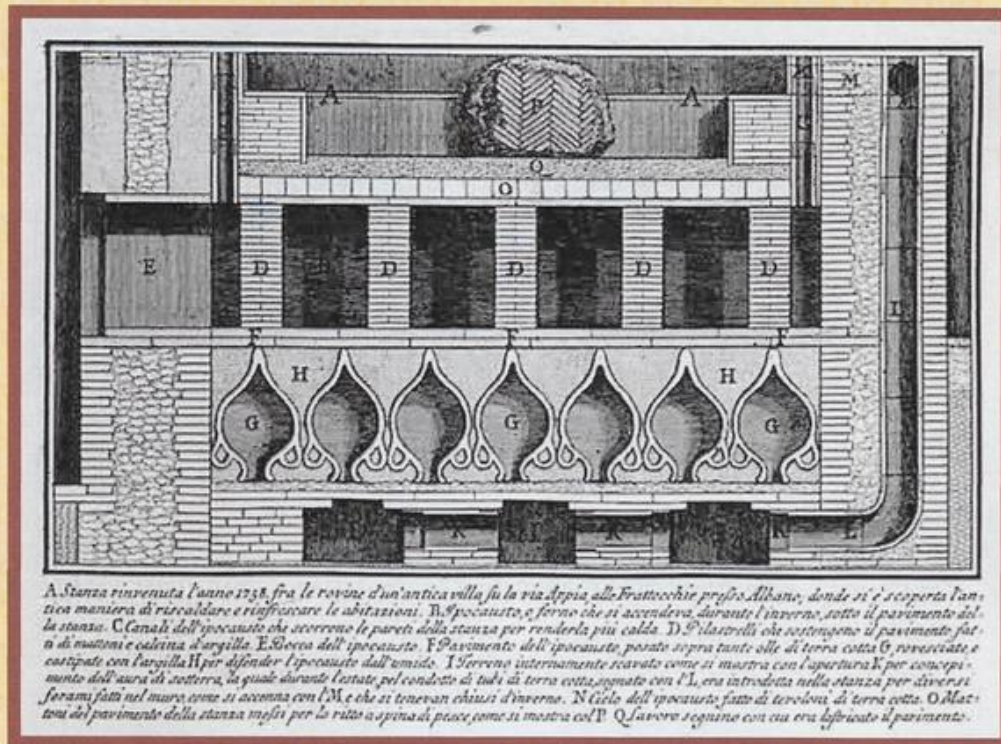


Netherby, Cumberland 1745, *Phil Trans* Vol.53, 1763

STOVES & VILLA ALLE FRATTOCCHIE



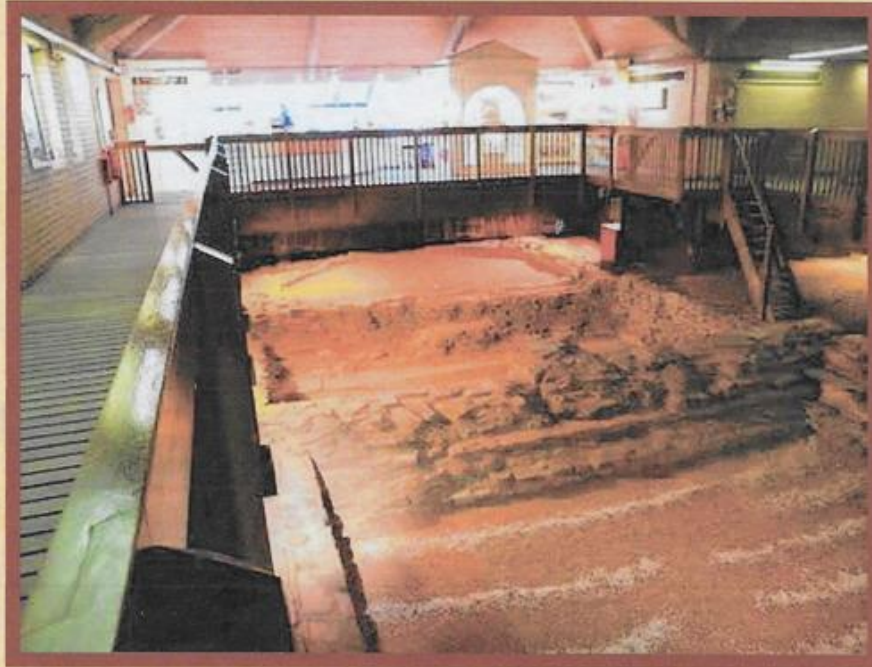
Old stoves, J J Winckelmann, Works 1832-34



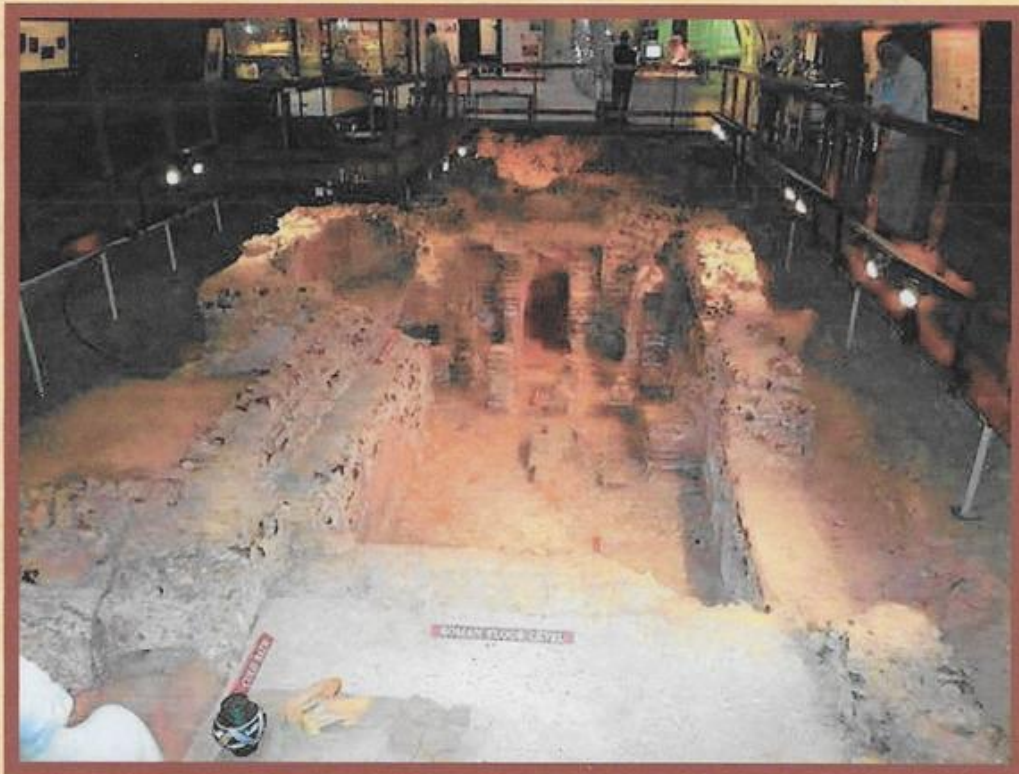
A Stanza rinvenuta l'anno 1758, fra le rovine d'un'antica villa fu la via Appia alle Frattocchie prof. Albano, donde si è scoperta l'antica maniera di riscaldare e rinfrescare le abitazioni. B. Ipocausto, e forno che si accendeva durante l'inverno, sotto il pavimento della stanza. C. Canali dell'ipocausto che scerreno le pareti della stanza per renderla più calda. D. Pilastrelli che sostengono il pavimento fatto di mattoni e calcina d'argilla. E. Bocca dell'ipocausto. F. Pavimento dell'ipocausto posato sopra tante file di terra cotta G. Forastate e costipate con l'argilla per difender l'ipocausto dall'umido. I. Terreno internamente scavato come si mostra con l'apertura K per concepi-mento dell'aura di scottura, la quale durante l'estate pel condotto di tubi di terra cotta, segnato con L, era introdotta nella stanza per diversi ferami fatti nel muro come si accenna con M, e che si tenevan chiusi d'inverno. N. Gilo dell'ipocausto fatto di terriboli di terra cotta. O. Mattoni del pavimento della stanza meglio per lo rito a spina di pesce, come si mostra col T. Q. Lavoro segnato con cui era lufficato il pavimento.

Villa alle Frattocchie, Piranesi 1764

HYPOCAUST AT CAERLEON & WELWYN



Caerleon

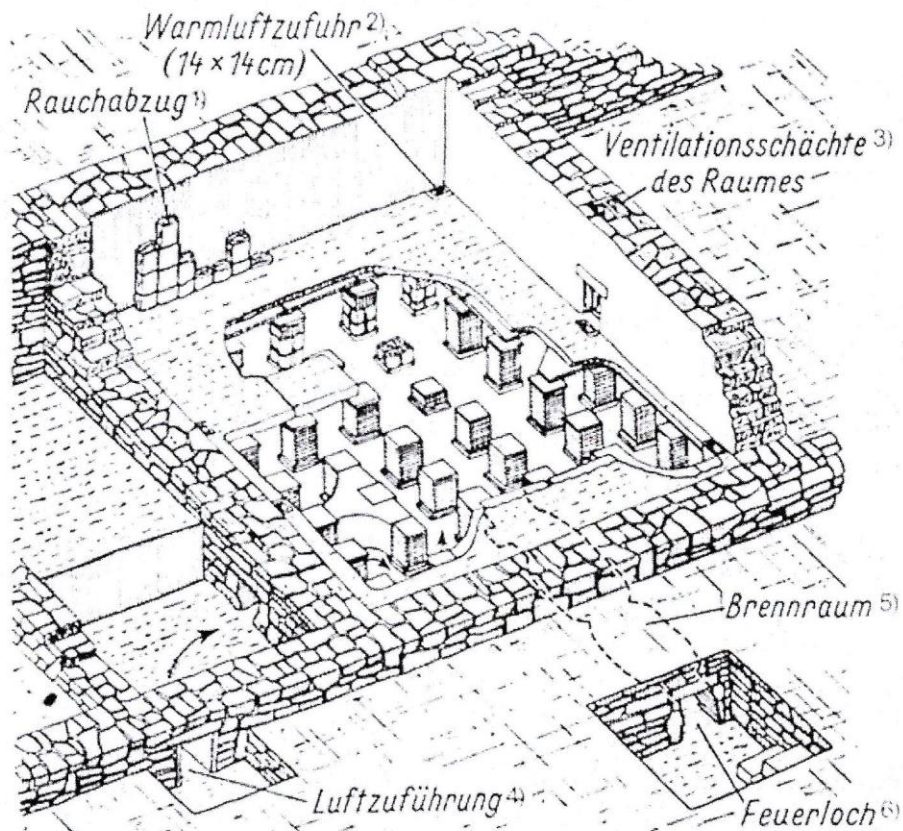


Roman bath, Welwyn

HYPOCAUST AT SAALBURG

3.1.4 The hypocaust

The hypocaust was devised by the Romans, and used for some centuries from about 80 B.C. to the end of the Roman Empire in 450 A.D. in the villas throughout Europe and Britain. In the Roman motherland, it was used almost exclusively for heating baths, and in a few large houses. Only after the destruction of Pompeii in 79 A.D. did the hypocaust begin to oust the brazier as a means of room heating. Some excellent examples are to be seen in Britain at Chester, Bath and Chedworth (Glos.), the last of these being perhaps the finest. Here the boiler was believed to have been made from thick sheet lead, supported on massive iron bars. In Europe, the castle at Saalburg and the baths at Trier are well preserved (Fig. 3.1). The hypocaust is said by Kretzschmer to have been devised by G. Sergius Orata in about 80 B.C.; it was described by Vitruvius in his book *De architectura* in 16 B.C. (56)



- 1) Fume extraction
- 2) Warm air supply
- 3) Room ventilating
- 4) Air intake
- 5) Fire chamber
- 6) Fire hole

Fig. 3.1. Hypocaust at Saalburg.

<11>

ROMAN BATHS HYPOCAUST IN BATH



BILLINGSGATE & JEWRY WALL LEICESTER



HYPOCAUST AT JEWRY WALL LEICESTER



HYPOCAUST AT JEWRY WALL LEICESTER

LEICESTER'S ROMAN FORUM TO-DAY: A CITY'S UNIQUE HERITAGE.

FROM THE DRAWING BY ALAN SORRELL. (SEE ARTICLE ON PAGE 136.)



EXCAVATIONS IN THE HEART OF LEICESTER DISCLOSE THE ROMAN FORUM BESIDE THE "JEWRY" WALL (RIGHT BACKGROUND), NOW PROVED PART OF THE BASILICA—THE PRESENT SITE, FOR COMPARISON WITH THE RECONSTRUCTION DRAWING OPPOSITE.

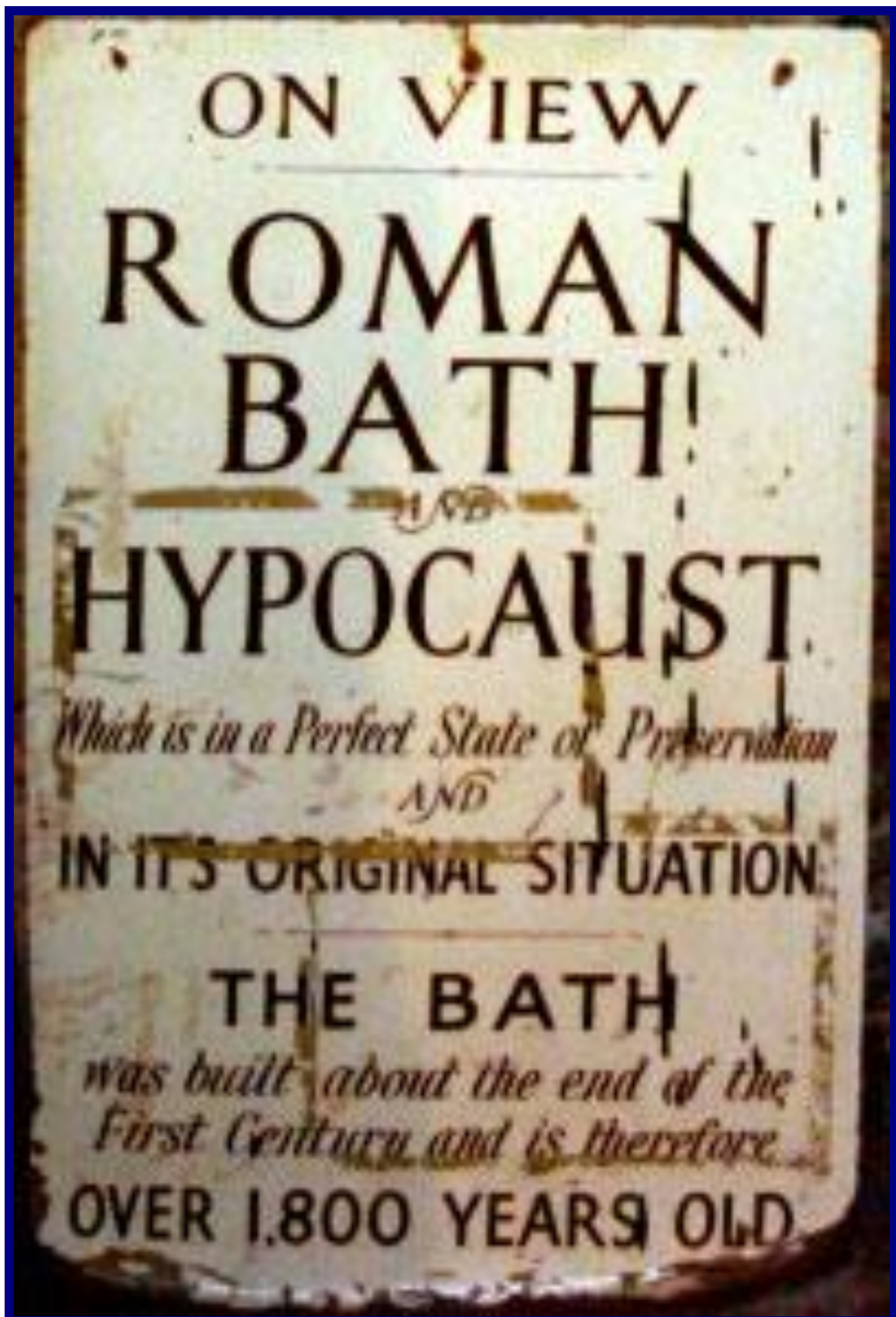
CHEDWORTH VILLA HYPOCAUST



CHEDWORTH VILLA HYPOCAUST



CHESTER HYPOCAUST

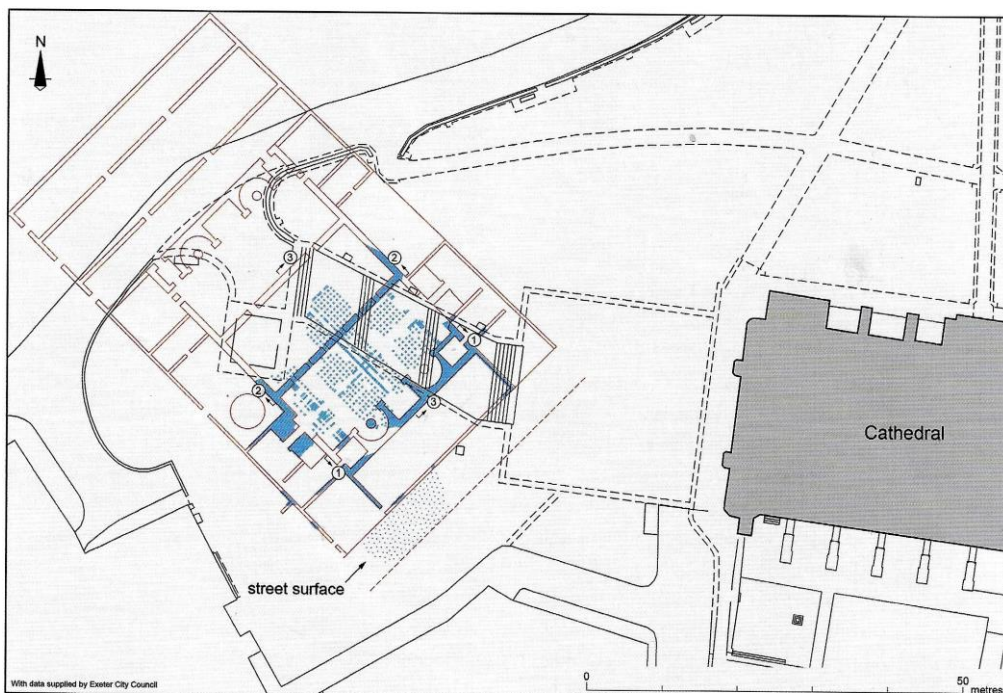


ROMAN BATHS HYPOCAUST AT EXETER

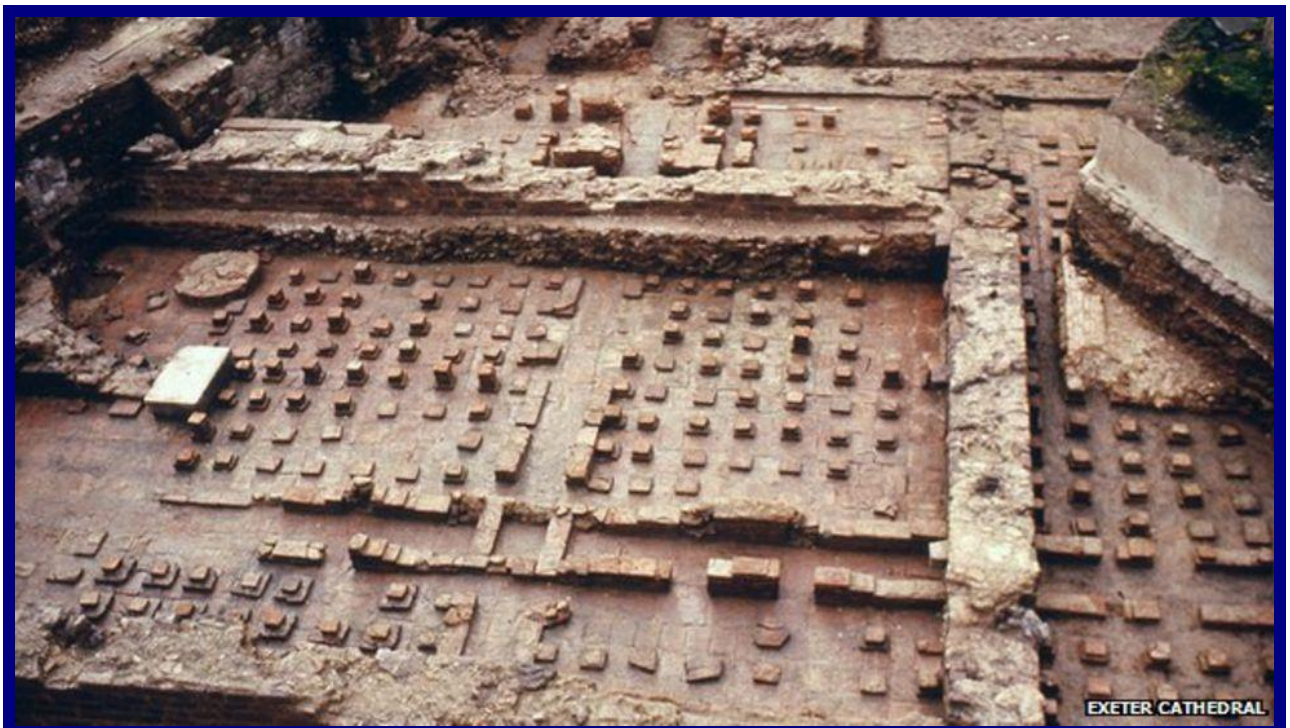


The ruins of the Exeter Roman Baths are not currently visible being buried just below the surface of Cathedral Green in front the West Facade of the Cathedral. The Bath House is believed to date from about 60 AD and contained hot, warm and cold baths with a large furnace house and hypocaust system. It was discovered over fifty years ago by workmen digging foundations for a new development.

A large-scale archaeological excavation was carried out in the early 1970's, but funding became an issue and the parties involved at the time were uncertain over what to do. So the decision was made to cover the Roman Bath House back over. Plans to uncover the Bath were considered in 2014-15. Funding was again rejected so the Baths remains buried.



ROMAN BATHS HYPOCAUST AT EXETER



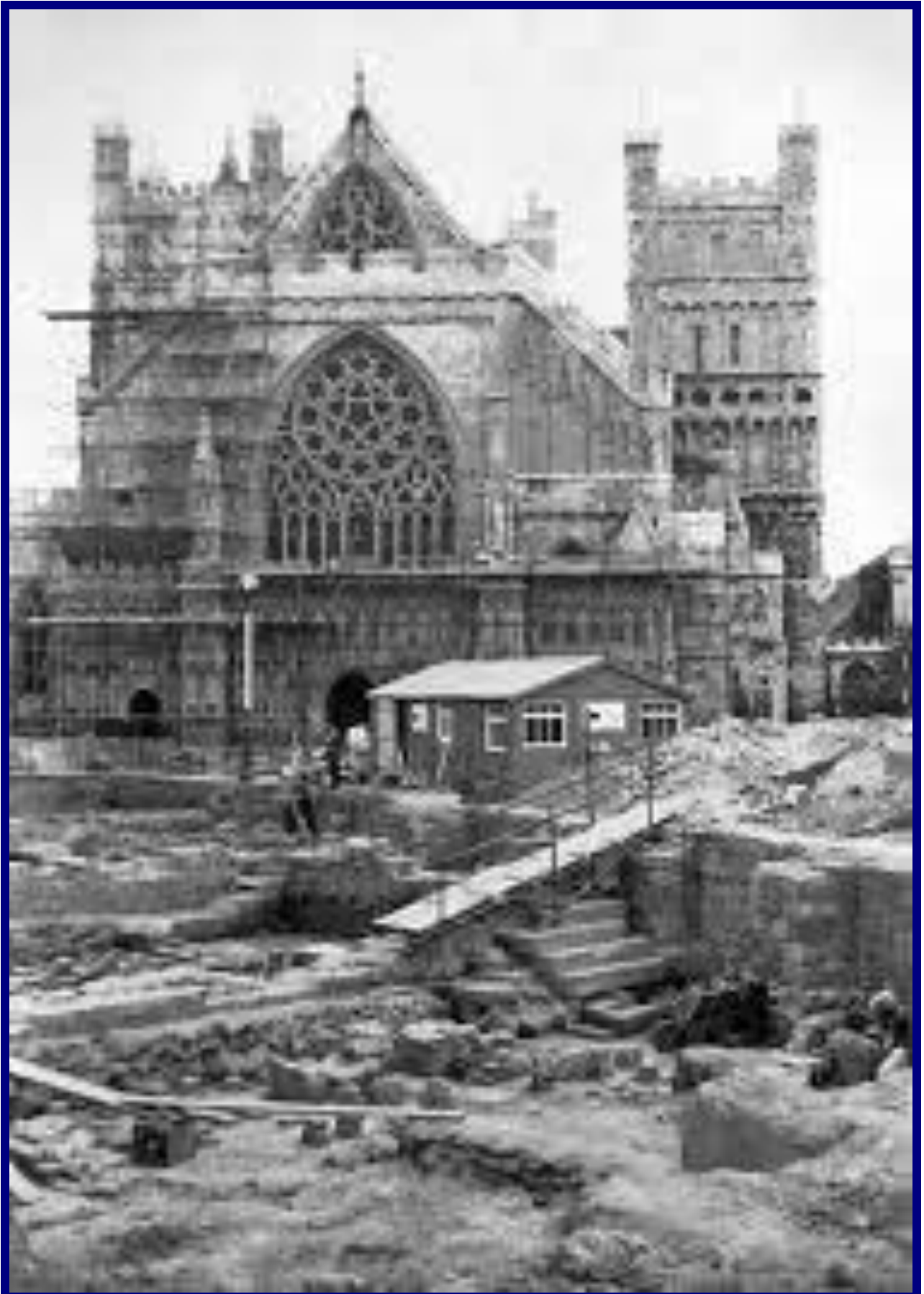
EXETER CATHEDRAL

ROMAN BATHS HYPOCAUST AT EXETER



<21>

ROMAN BATHS HYPOCAUST AT EXETER

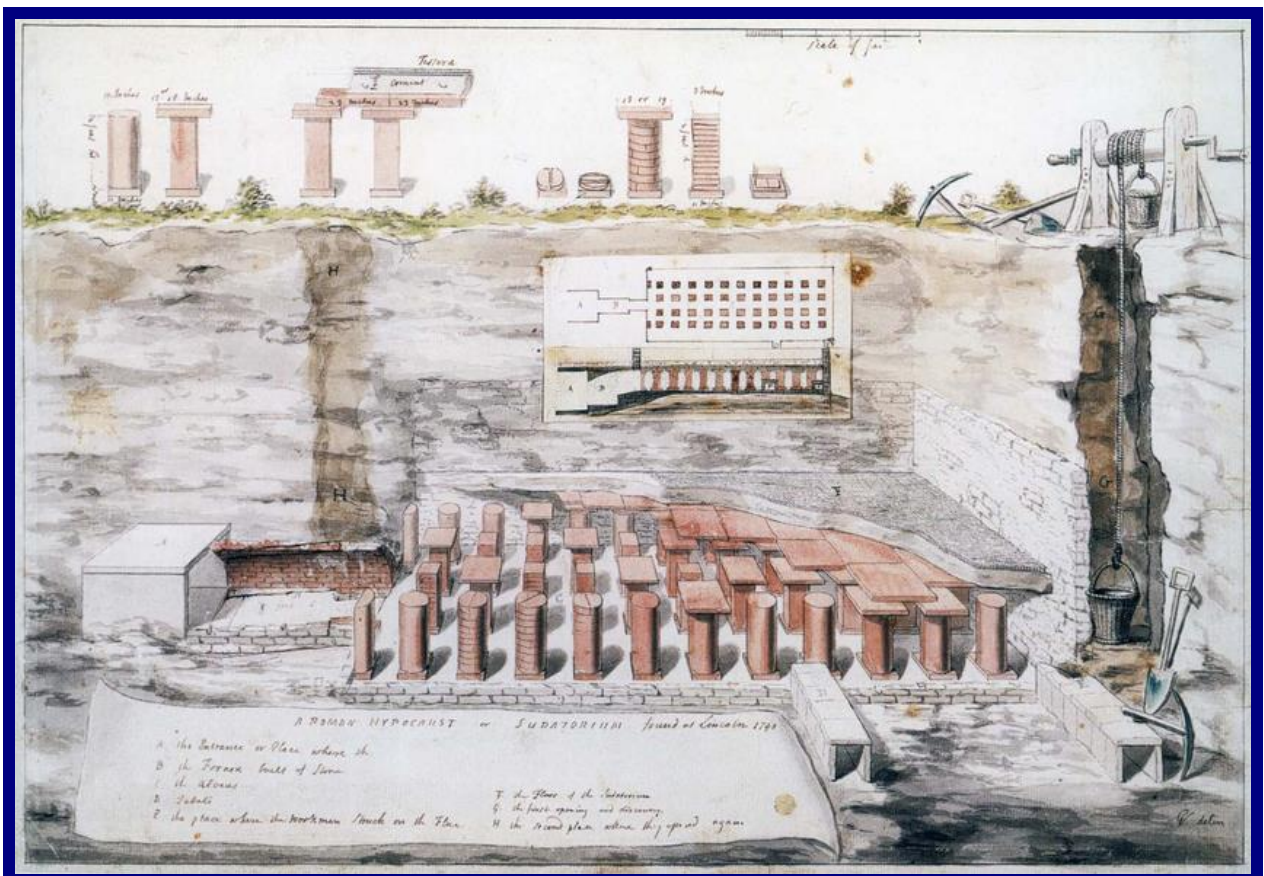
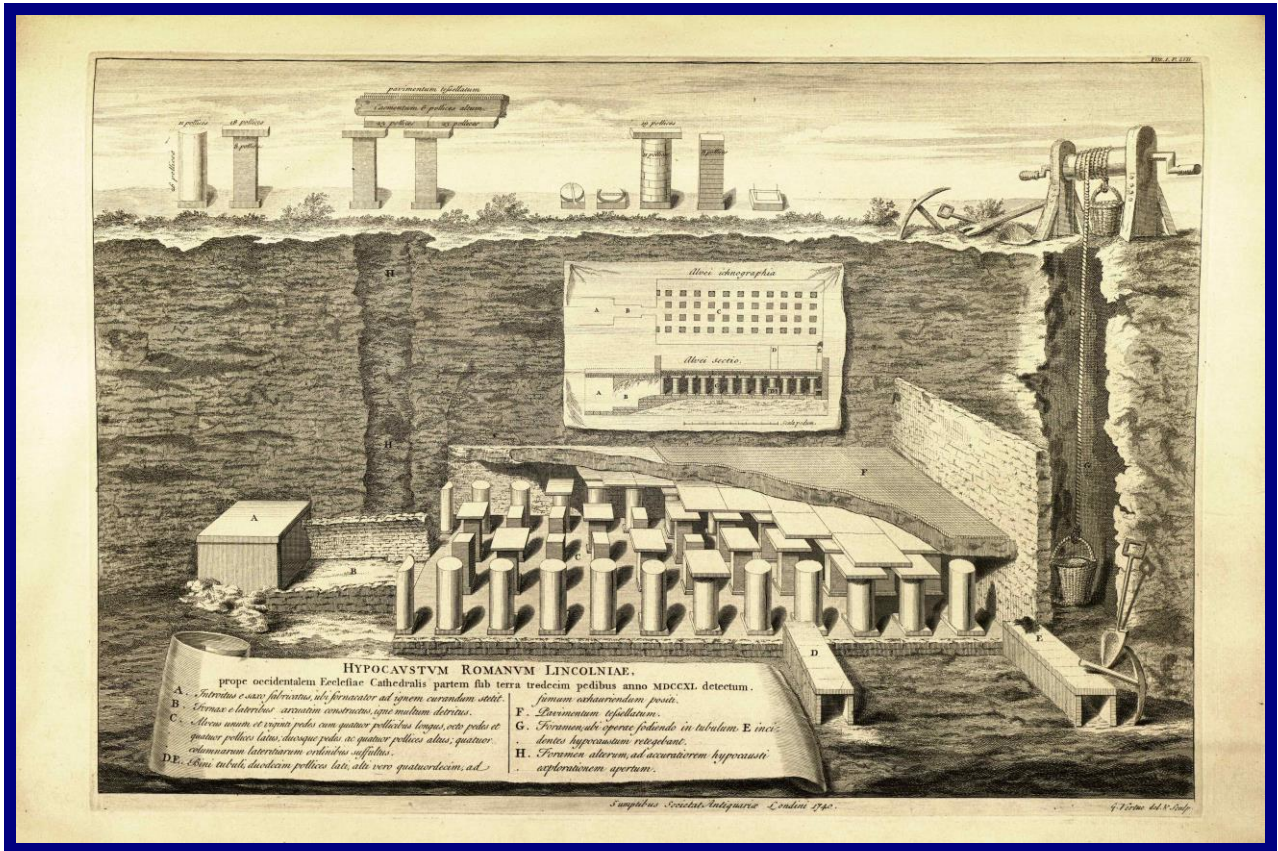


<22>

ROMAN BATHS AT EXETER



HYPOCAUST AT LINCOLN



<24>

FRANCE- HYPOCAUST AT ARLES



<25>

ISRAEL- HYPOCAUST AT BETH SHEAN

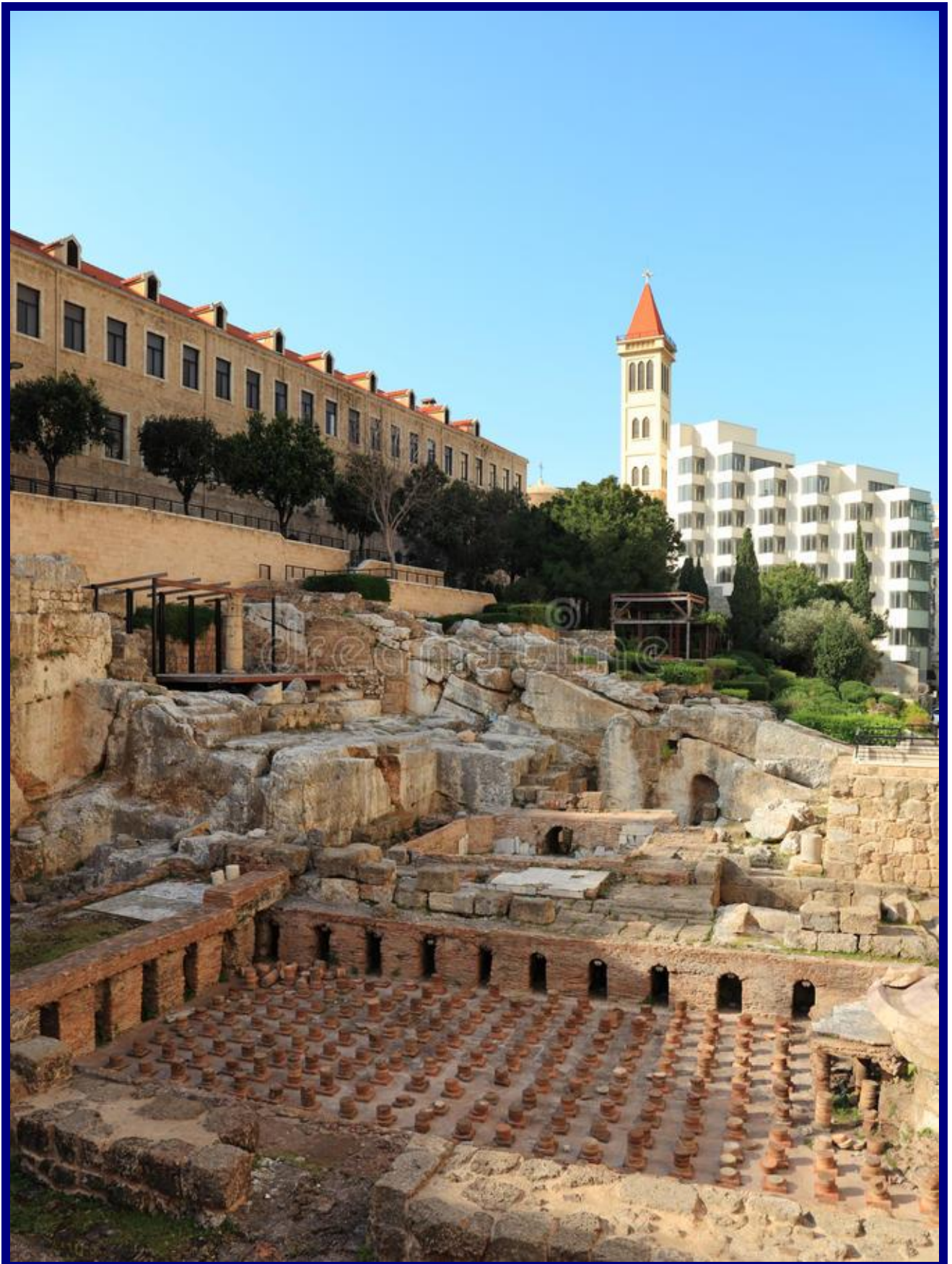


ISRAEL- HYPOCAUST AT CAESAREA



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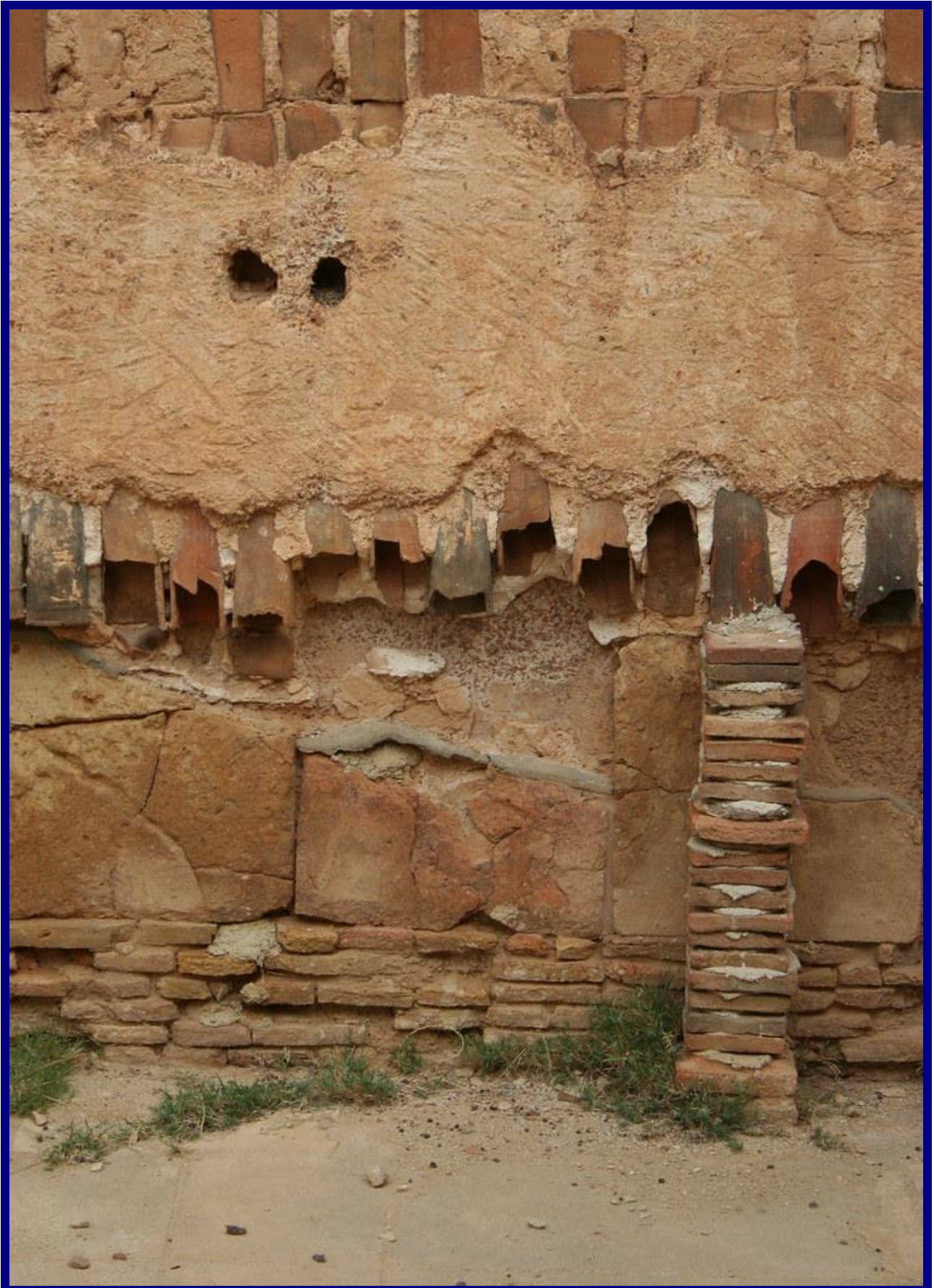
LEBANON- HYPOCAUST IN BEIRUT



LIBYA- HYPOCAUST AT LEPTIS MAGNA



LIBYA- HYPOCAUST AT LEPTIS MAGNA



TURKEY- HYPOCAUST IN ANKARA



THE HYPOCAUST

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- 1982 Building Services Engineering: A Review of Its Development, Neville S. Billington and Brian M. Roberts, Pergamon Press, Oxford.
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- 1998 Vitruvius: The Ten Books of Architecture (10-15 BC), Translated by Morris Hicky Morgan, Dover Publications, New York.
- 2013 La Scoperta Dell'Acqua Calda (The Discovery of Hot Water), Carlo Manfredi, Maggiola Editore, Milan.
- 2022 The Hypocaust (Heat Storage): Part Two, Brian Roberts (E-Book), CIBSE Heritage Group website.

See CIBSE Heritage Group website: E-Books General/Systems & Equipment/Hypocaust Heating*

* Contains large text abstracts of many of the books listed above.

See also: Wikipedia "Hypocaust" and "exploringexeter.co.uk/exeter-roman-baths-history-devon": Secret history: Exeter's Roman Baths, by Jamie Ransom.