

Mellor Archaeological Trust: Friends Update Evening

14 March 2009

"What is Amber", a presentation by Philip Day, School of Chemistry, University of Manchester.

This talk relates to the discovery of around 60 amber beads at Shaw Cairn during excavations there in 2008. The beads were found in an Early Bronze Age burial cist, and probably indicate the importance or status of the person being buried. This is a rare find for this part of England, and is of major national importance. See for example:

<http://news.bbc.co.uk/1/hi/england/manchester/7758075.stm>

<http://www.manchester.ac.uk/aboutus/news/archive/list/item/?id=4214&year=2008&month=12>

At the request of the Mellor Archaeological Trust, these beads have been consolidated and conserved by Dr Sonia O'Connor, Department of Archaeology, University of Bradford, and strung to form a necklace consistent with the functions of the various beads. The beads are currently being examined by Dr Alison Sheridan (Head of Early Prehistory in the [National Museums of Scotland](#) Archaeology Department, Edinburgh), and her report is expected shortly.

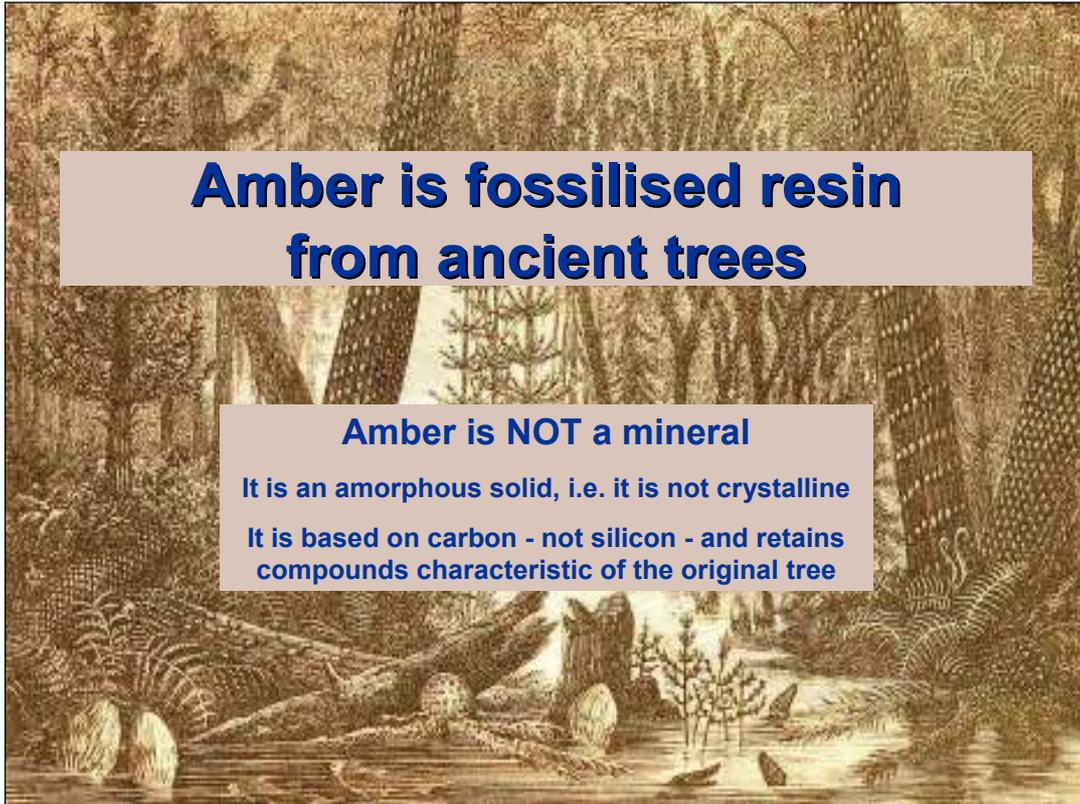
In the meantime, I have been examining some of the smaller fragments of amber recovered with the beads, to determine the likely source of the amber by means of various physical and chemical tests.

Source material for this talk is acknowledged at the end.



1. The Colours of Amber

This slide merely illustrates that "amber" need not be the traditional amber colour. All these pieces of amber are their natural colours, which range across the whole spectrum, from deep red, through orange and yellow (the "normal" colours of Baltic amber) to green, blue and violet (more usually associated with Dominican amber). So-called "black" amber is usually very dark red.



2. Amber is the fossilised resin from ancient trees. Amber is NOT a mineral for the reasons given. To some extent, amber is similar to coal, both in origin and in its carbon-based chemistry.

A very good general site on amber is to be found at:

<http://www.emporia.edu/earthsci/amber/amber.htm>

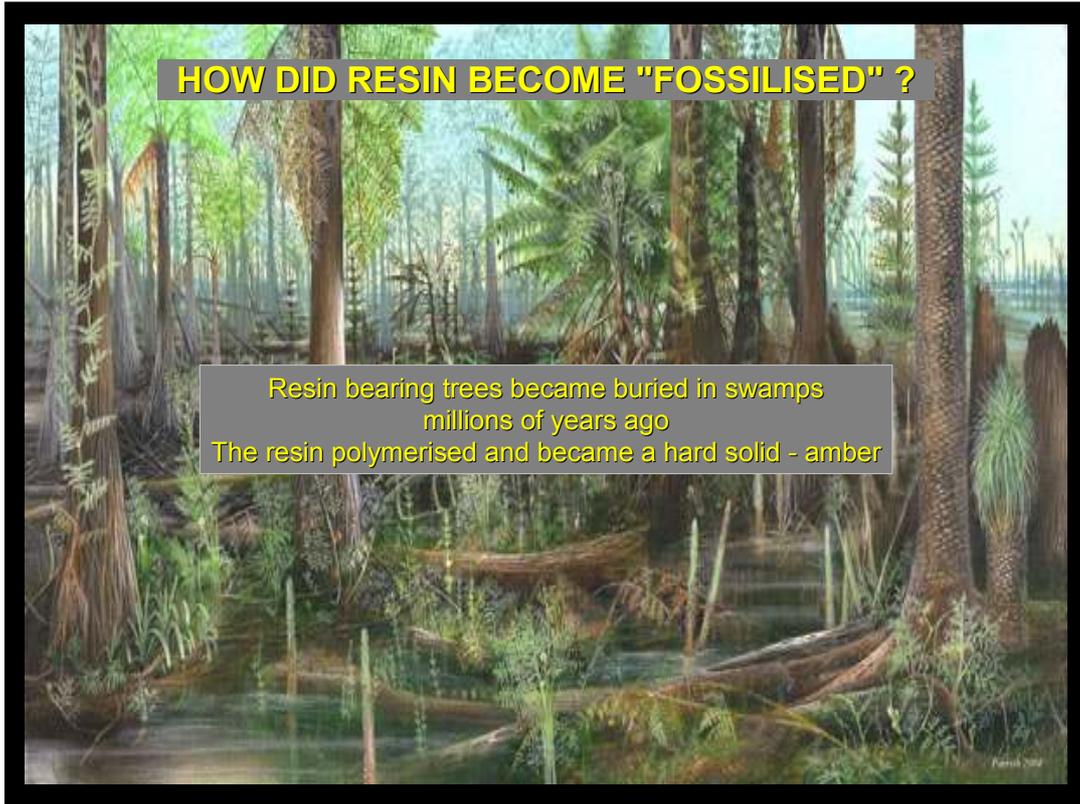


3. Modern tree resins

Examples of well-known resinous modern trees are the Scots Pine (UK and Europe) and the Kauri Pine (New Zealand). Although the type of tree from which Baltic amber probably originated are certainly not the Scots Pine, it may have been related to the New Zealand Kauri Pine.

Resin is NOT tree sap (which is the aqueous solution flowing up the tree from the roots, carrying the various nutrients). Rather, resin is a visous, sticky material exuded from wounds in the tree bark, or internally, and helping the seal the tree against further insult or attack. Insects and other plant and animal life frequently gets caught up in tree resins, and as a result amber sometimes contains fossilised remains of these organisms, much to the delight of *paleobiologists*:

<http://www.emporia.edu/earthsci/amber/life.htm>

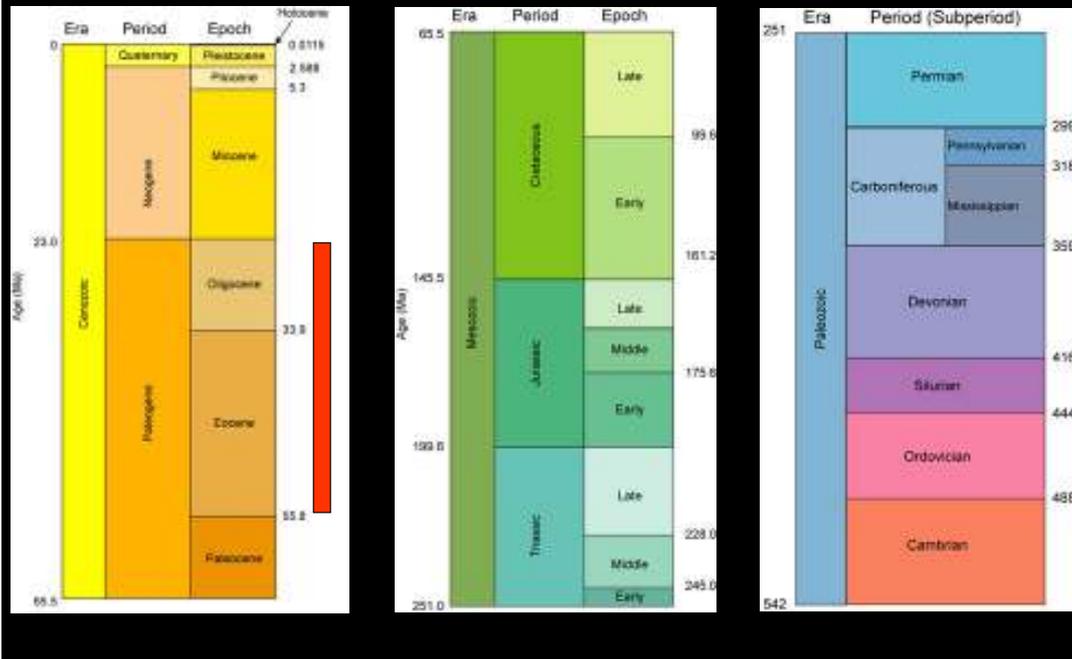


4. How did the fossilisation process occur?

Resin bearing trees became buried in swamps millions of years ago. The resin polymerised and became a hard solid - amber.

Chemically, the original resin would have consisted of various *terpenes* which polymerised slowly over the course of time (millions of years). This process would only occur in the almost complete absence of oxygen (air) as otherwise the resin would oxidise and degrade. Burial in a wet, swampy, carbon-laden and hence anaerobic environment would be a good set of conditions for amber formation.

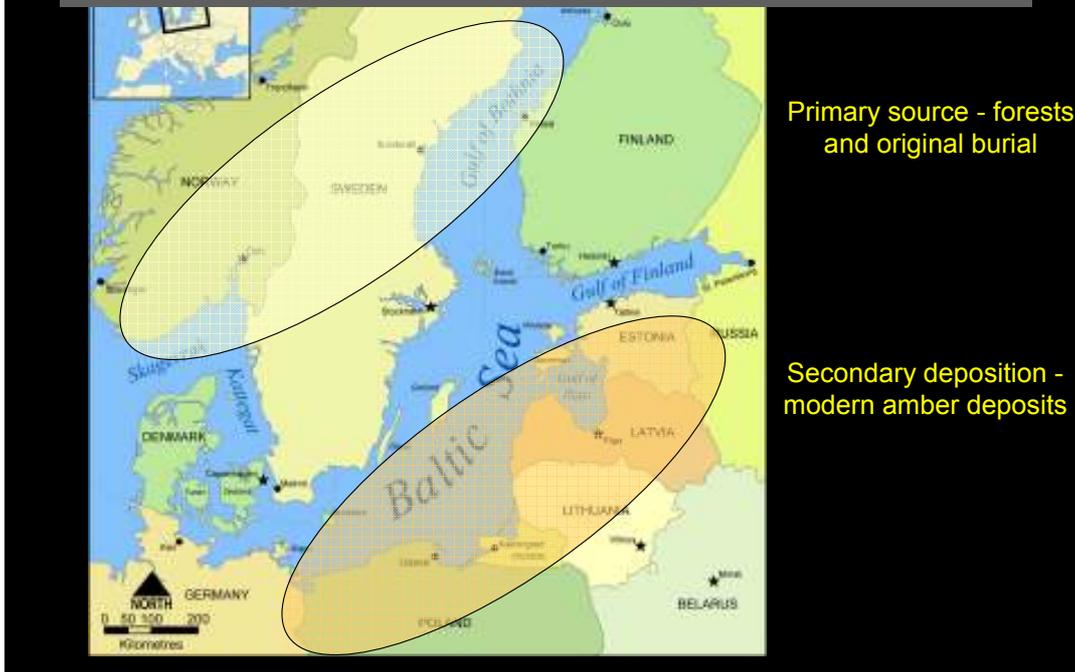
When ?



5. When did all this occur?

Amber varies in age from around 400 - 2 million years, although most European/Baltic amber originated from trees living during the period 20 - 55 million years ago (the *eocene* and *oligocene* epochs).

Where did this happen ?



6. Where did this occur ?

Amber found in Britain is thought to have originated in the South Baltic region in the eocene/oligocene. Thus, it is stated that the Baltic amber forests grew in *Eocene Scandinavia* in a temperate to subtropical climate:

<http://www3.interscience.wiley.com/journal/117997171/abstract>

The remains of these forests later became deposited in sediments along the southern shore of the *eocene sea*, which is now the area to the south of the Baltic. Strictly, these are *secondary* deposits, although often regarded as the primary depositional source. These deposits have been and are mined for their amber, and this forms the largest area for world amber supply (the Dominican Republic is the second major source of world amber). Thus, major supplies of Baltic amber come from the Samland Peninsula (Kaliningrad), the Baltic States (Lithuania, Latvia and Estonia), and Poland. See:

(see next page for countries with amber museums)

Where does Baltic Amber occur ?



Baltic countries:

Kaliningrad
Poland
Baltic States
Finland
Sweden

Eastwards:

Ukraine
Russia
Romania?

Westwards:

Denmark
N. Germany
N. France
Britain (E. coast)

Transported by glaciation

7. Where does Baltic Amber occur ?

Movement of water and/or ice has transported the original deposits of Baltic amber to neighboring countries, and also further afield. See:

<http://www.emporia.edu/earthsci/amber/museum.htm>

http://www.amber.com.pl/eng/art/museum_kaliningrad.php

http://www.li.lv/index.php?option=com_content&task=view&id=47&Itemid=1149

http://samogitia.mch.mii.lt/KULTURA/palanga_museum_en.lt.htm

<http://www.ambergallery.lt/english/galerija-m-saulys.htm>

http://www.culture.pl/en/culture/artykuly/am_mu_bursztynu_gdansk

Amber in Britain is found on the East Coast, from Suffolk to North Yorkshire.

What is unique about Baltic Amber ?

Succinic Acid content, 2 - 8%
Recorded by Pliny the Elder (23 - 79 AD)
Latin for Amber = Succinum (lit. "juice")

For this reason, Baltic Amber is classed as

SUCCINITE

Amber when rubbed with fur becomes electrically charged.

In Ancient Greece, amber was named "elektron" giving rise to the modern name "electron"

8. Baltic Amber

Much of the research into the nature of Baltic amber, and particularly its identification by physico-chemical means, is associated with the work of Beck, from the Amber Research Laboratory, Vassar College, USA:

<http://chemistry.vassar.edu/ar1/research.html>

See also:

<http://www.emporia.edu/earthsci/amber/physic.htm>

<http://www.emporia.edu/earthsci/amber/ident.htm>

Where does Non-Baltic Amber occur ?

EUROPE:

S. Germany
France
Switzerland
Spain
Italy
Sicily

ASIA:

Japan
China
Burma
India

S. HEMISPHERE:

Australia
New Zealand (Copal)
S. America

NEW WORLD:

Dominican Republic
USA (most states)
Canada

Very few non-Baltic ambers resemble *succinite* in having a high content of *succinic acid* (Canadian amber is an exception)

9. Succinite

The most characteristic component of Baltic amber is succinic acid, first recognised by the Romans (see Pliny, 23-79 AD:

<http://groups.google.com/group/amber-road/web/amber-finding-locations-in-naturalis-historia-by-pliny>

Before the advent of spectroscopic techniques, the ability to distil succinic acid from amber was regarded as strong evidence for its Baltic origins.

Baltic amber is more or less synonymous with *succinite* (the mineralogical name). The other main category of amber is *retinite*.

AMBER in ARCHAEOLOGY

Used for beads, necklaces, ornaments from Mesolithic times

Oldest amber artefact in Europe (France, ca. 17000 BC)

**Oldest amber artefact found in Britain:
Gough's Cave, Cheddar (Mesolithic, ca. 10000 BC)**

British amber finds from Neolithic onwards

Most BC amber finds in Early Bronze Age (very high quality craftsmanship)

Many Anglo-Saxon and Viking finds of high quality

10. Amber in European and British Archaeology

The oldest amber to have been found in Britain was a piece of raw amber found in Gough's Cave, at Cheddar. Although raw, this amber could only have reached this cave (at the so-called "mesolithic level") through transport by humans, and may therefore be regarded as an artefact.

Beck's infrared analysis of this amber shows it to be succinite.

Amber was used to create decorative objects in the mesolithic and neolithic ages (small number of recovered objects in Britain), but was widely used in the Early Bronze Age. Its use then appears to have fallen off, until Roman and later Saxon times, from which a large number of artefacts have been recovered).

ARCHAEOLOGICAL TIMELINE in BRITAIN

Paleolithic	450,000 - 10,000 BC
Mesolithic	10,000 - 4500 BC
Neolithic	4500 - 2300 BC
Bronze Age	2300 - 700 BC
Iron Age	700 BC - 43 AD
Roman	43 - 410
Anglo-Saxon	410 - 1066
Viking	793 - 1066
Norman	1066 - 1154

Sources:

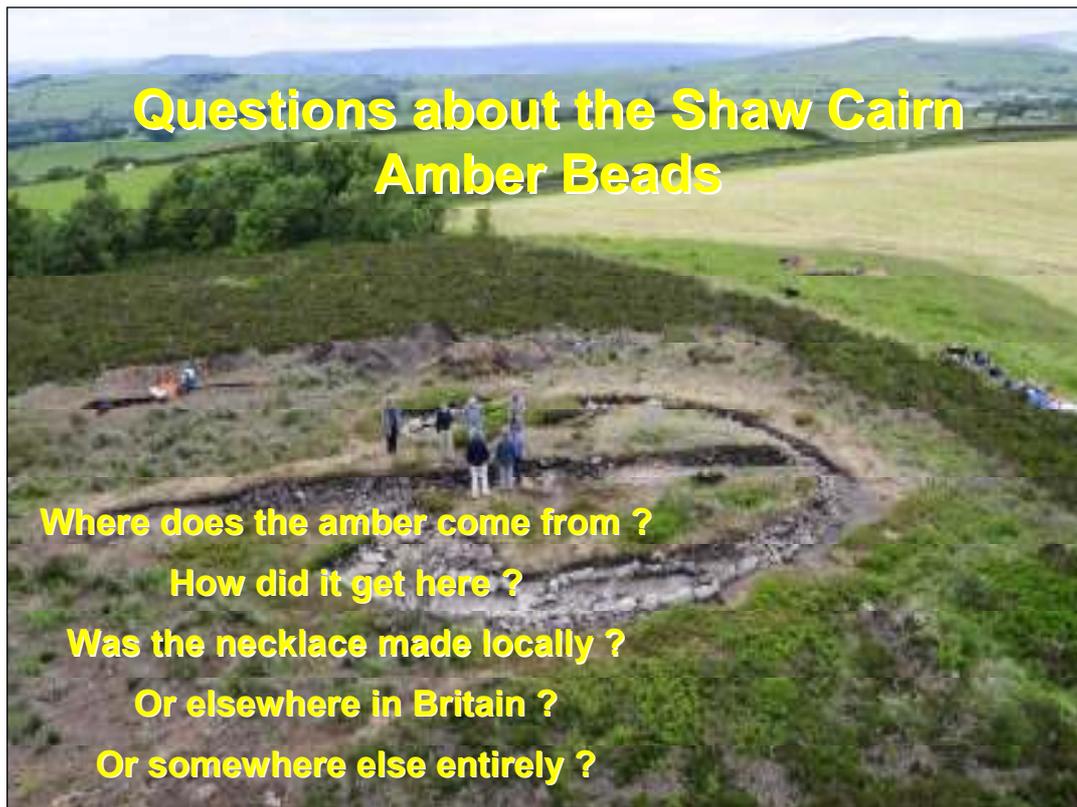
www.bbc.co.uk/history/archaeology/excavations_techniques/launch_tl_ages_treasure.shtml
www.bbc.co.uk/history/interactive/timelines/treasure/index.shtml

11. Archaeology: Timeline in Britain

See:

www.bbc.co.uk/history/archaeology/excavations_techniques/launch_tl_ages_treasure.shtml

www.bbc.co.uk/history/interactive/timelines/treasure/index.shtml



12. The Amber Beads from Shaw Cairn

The discovery of the amber beads in 2008 is undoubtedly one of the most important finds from the excavations of the Mellor Archaeological Trust, but it does raise a number of intriguing questions, such as:

Where does the amber come from ?

How did it get here ?

Was the necklace made locally ?

Or elsewhere in Britain ?

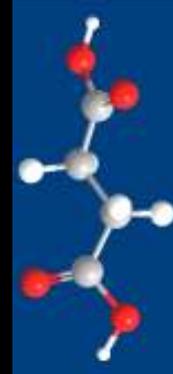
Or somewhere else entirely ?

These can only be answered by reference to *chemistry* (to establish the global source of the amber) and *archaeology* (to help decide by what route(s) the amber may have reached Mellor).

CHEMISTRY of BALTIC AMBER



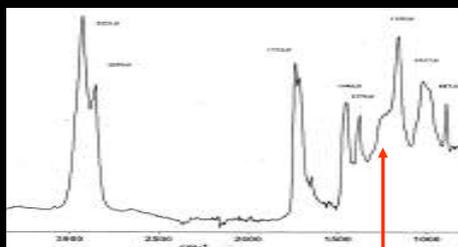
Polymerised *terpenes*
High content of *succinic acid*
Characteristic *infrared spectrum*



14. The Chemistry of Baltic Amber

Baltic amber (succinite) is a polymer formed from diterpenoid compounds, and also contains succinic acid, either as the free acid or as an ester with terpene alcohols. For a wide-ranging review, see C.W.Beck, Spectroscopic Investigations of Amber, Applied Spectroscopy Reviews, 1986, 22, 57-110.

INFRARED SPECTRA Baltic vs. Shaw Cairn Amber



Baltic amber (Kaliningrad)

Spectrum from the
National Museum of Denmark



Shaw Cairn amber

Spectrum from the
University of Manchester

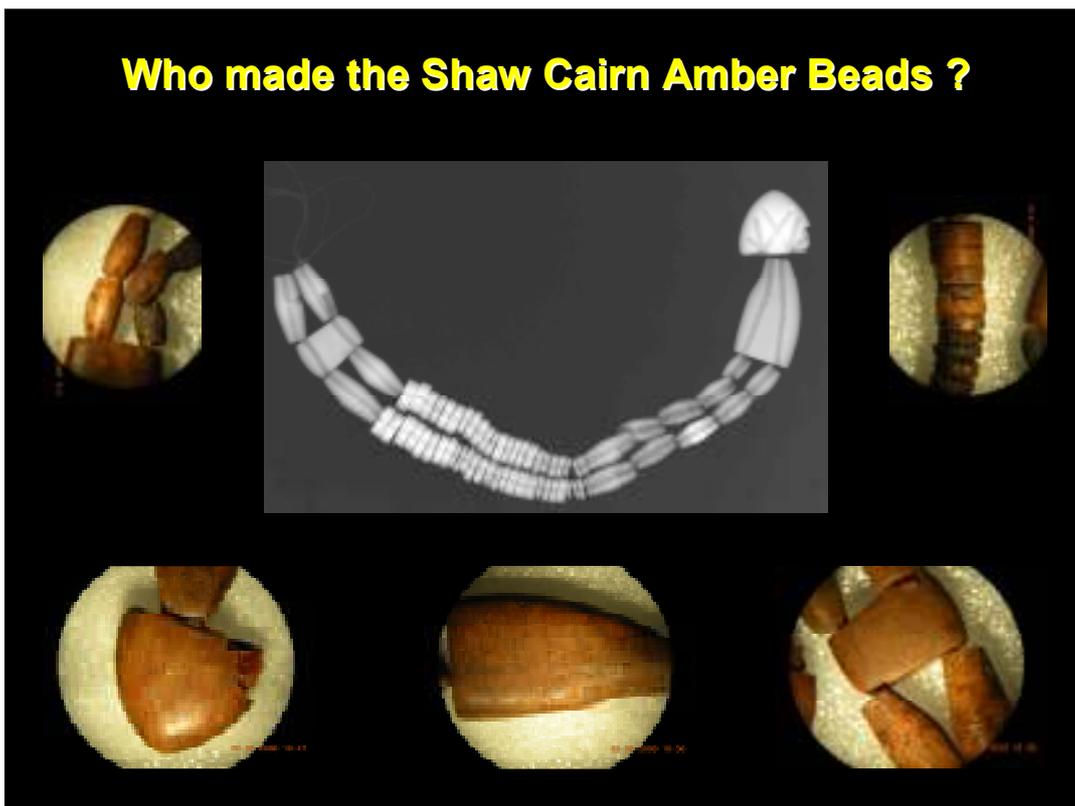


14. Infrared Spectroscopy at the University of Manchester

This establishes unequivocally that the amber found at Shaw Cairn is *succinite*. The chemical investigation does not, of course, help establish how the amber got to the Cairn.

The two spectra shown are: (a) from an authentic sample of succinite, taken at the National Museum of Denmark (Sheshona, 2002), and (b) from an untreated sample of Shaw Cairn amber (provided by Sonia O'Connor). Both IR spectra were recorded on FTIR instruments, using Attenuated Total Reflectance (ATR) methodology.

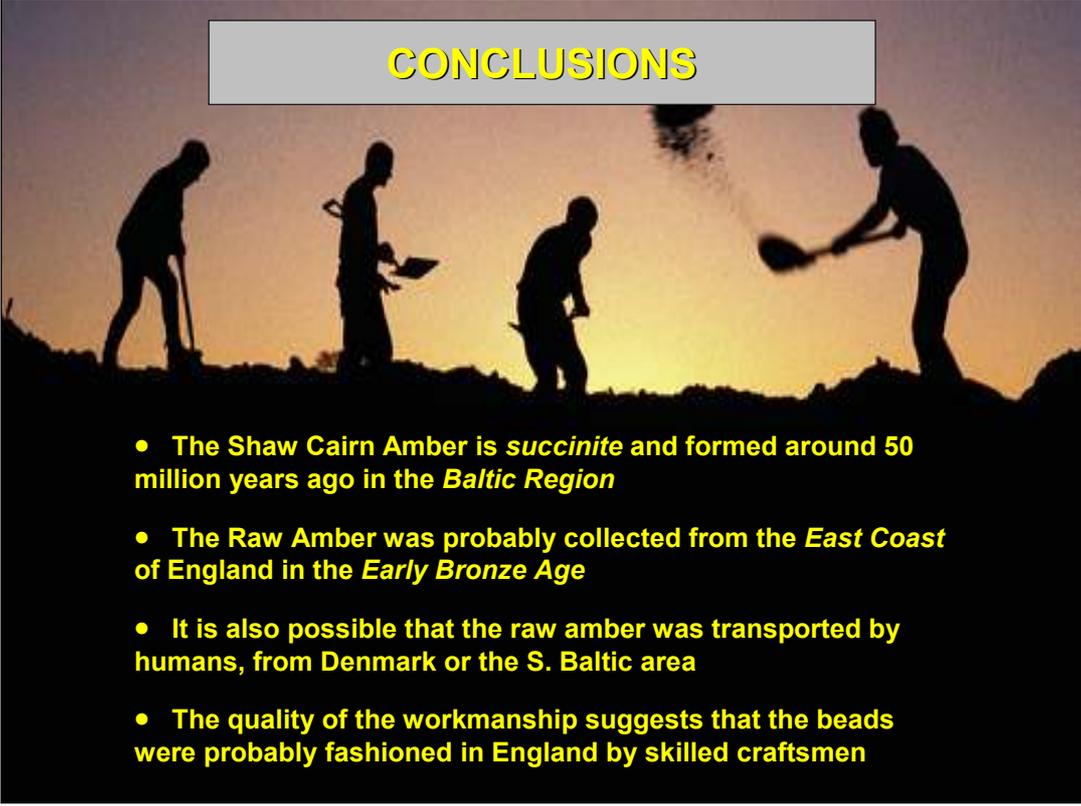
Who made the Shaw Cairn Amber Beads ?



15. Who made the Shaw Cairn Beads ?

The very high standard of workmanship - the exact roundness of the disk beads, the symmetry of the spacers, and most importantly the precision of the holes drilled through the beads - suggests a similarity with beads (particularly spacers) of this type found from EBA sites in Hampshire and Dorset. Very few examples of this standard of precision have been found from continental Europe.

The most likely conclusion is that the beads were fashioned from raw amber somewhere in England, and probably in the Wessex region, or by Wessex craftsmen who had travelled north. The raw amber may have been recovered from East Coast beaches, or may have been imported from Denmark or further beyond.



CONCLUSIONS

- The Shaw Cairn Amber is *succinite* and formed around 50 million years ago in the *Baltic Region*
- The Raw Amber was probably collected from the *East Coast* of England in the *Early Bronze Age*
- It is also possible that the raw amber was transported by humans, from Denmark or the S. Baltic area
- The quality of the workmanship suggests that the beads were probably fashioned in England by skilled craftsmen

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For more information to support these conclusions, see:

Amber in Pre-historic Britain, Curt Beck and Stephen Shennan, Oxbow Books, Oxford, 1991.



THE END

If you have been,
Thank You for Listening



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