# Object Lessons 1 : Metals


Social History Curators Group

# Object Lessons 1: Metals

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# 1. How to use this box

The purpose of this box is to help you identify and care for metals commonly found in social history collections. It is aimed at people with little or no prior knowledge of metals and their properties, or as a refresher course for those who want to brush up their understanding of collections' identification and care. It is intended as a starting point for further exploration. By the end of this pack you should be able to make a positive identification of most of the major metals found in typical museum objects. However, you might wish to follow up with further study into technicalities of metals manufacture and more detailed histories of production and use in your region.

The box is designed for use as part of a programme of self-directed learning. You can use it on your own, or in a small study group. You might also wish to take it into a store, as a point of comparison with other objects whilst undertaking documentation work.

The box can also be used to support a one-day training seminar, facilitated by a conservator, curator or other metals expert. For guidance on how to organise such a seminar, please turn to Appendix 4.

## Getting started

You will need a clear, clean tabletop to lay the objects out on. The box contains 20 objects made of different metals. Not all the metals are represented (for example, there are no objects made of gold or platinum), and some metals are represented more than once. A few objects are a mix of more than one metal.

The resources may be read in any order, either with or without the objects. However, it is intended that the two are used together. Throughout the written resources are clues to help you confirm your identification of the objects, or to show you particular examples to look at.

First unpack the objects and the set of identification labels. Examining the objects closely, take a first guess at the identification of each object, by placing a label card in front of each. Six objects tell you what they are made of through their marks, so these should be easy to separate out! You may also find you know more than you think.

Once you have made a preliminary identification, you can either work through this folder sequentially, considering your choices as you go, or you can pick one particular metal to study at a time.

> **A note on the use of gloves:** Ordinarily, nitrile gloves must always be worn when handling metals. Salts in sweat will cause permanent damage to the surface of the metal if you don't. However, SHCG is happy for the items in this box to be handled without gloves, as the objects have been chosen to illustrate some kinds of corrosion that are typical in metals. You may prefer to wear gloves if you do not wish to get dirty.

# 2. Metals: The basics

Metals are a group of elements which are solid at room temperature (with the exception of mercury), composed of a crystalline structure.

They are good electrical and thermal conductors. They are lustrous when polished.

Metals are mostly mined in a mineral state commonly known as metal **ore**. This is the most natural and stable state of the metal. But metals are rarely used in their pure form; they are more usually mixed (or **alloyed**) with one or more other metals or elements. This gives them a variety of different characteristics and properties, which enhances their versatility. Alloys are extremely difficult to identify precisely without chemical analysis, but the predominant metal in an alloy can usually be guessed at by considering the appearance, age and function of the object in question.

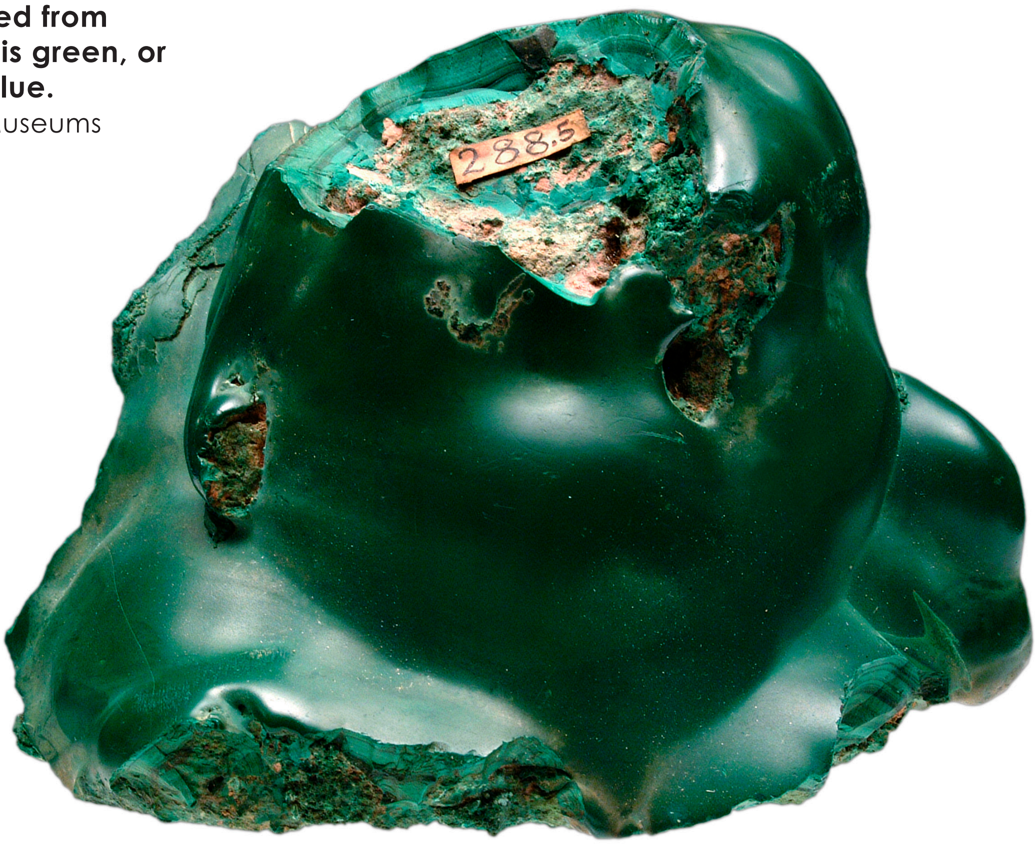
To extract a metal from its ore requires a number of processes which consume high amounts of energy (think of blast furnaces and smelters, for example). As a general rule of thumb, the more energy that is required to physically extract the metal from the ore, the more subject to corrosion the resultant compound will be. So gold, mined as metallic gold which requires little energy to convert it for use, is very stable and corrosion resistant. Conversely, iron ore is smelted to separate the iron from numerous impurities and then alloyed; it is considered to be unstable as it corrodes or rusts easily. Because of this, stable metals such as gold and silver may be referred to as **noble** metals. **Base** metals are those that corrode more readily.

## The order of corrosion tendency:

Corrosion is the reaction of the metal with its environment. It is a chemical change which takes place as the metal tries to revert back to its ore. It is sometimes possible therefore to identify the main metal an object is made from by examining the products of corrosion. For example, iron is commonly extracted from ores of hematite and magnetite, which are orange/ brown - the colour we associate with rust.

| | |
|---|---|
| Gold | **Noble** - Electropositive |
| Platinum | |
| Silver | |
| Copper | decreasing stability |
| Lead | |
| Tin | |
| Iron | increasing corrosion tendency |
| Zinc | |
| Aluminium | |
| Sodium | |
| Potassium | **Base** - electronegative |

**Copper is extracted from malachite, which is green, or azurite, which is blue.**



**Copper corrosion products are therefore typically green/ blue, as the metal is reverting to the ore from which it has been extracted. Here you can see corrosion on a copper token issued by John Harrop of Gateshead, a dealer in 'Fine Teas and Raw and Roasted Coffee'.**

## 3. Identifying metals: easy places to start

A few simple techniques should quickly help you narrow the range of possibilities for your identification of an object.

First, take the magnet in the box and see if any of the objects are attracted to it.

**Is the object magnetic?**

**yes** → go to iron, steel, tin [pages 5-9]

**no** → go to next test

**Is the object yellow, orange or gold in colour?**

**yes** → go to gold, copper, brass, bronze [pages 10-15]

**no** → go to next test

**Is the object silvery, with a hallmark, touchmark or any other form of maker's mark?**

**yes** → go to silver, pewter, nickel silver, Britannia metal [pages 17-21], stainless steel [page 8]

**no** → go to next test

**Is the object silvery/ grey but without a hallmark?**

**yes** → go to lead, zinc, aluminium

**Does the object have signs of corrosion?**

**If these are greenish in colour** → go to copper, brass, bronze

**If these are whitish in colour** → go to lead, aluminium

**If these are orangey (rust) in colour** → go to iron, steel

**Still stuck?**
Consider the function of the object. What properties does it require to do its job, and how does that match up to the different properties of the metals described in the following pages?

# 4. Test 1: Is the metal magnetic?

**If yes, it will be iron, steel or tinplate.**

## 4.1 Iron

**Appearance**
Iron is a silvery-white metal in its pure state. In both wrought and cast form it is often black in colour.

**Properties**
Iron is easy to identify because it is magnetic. It is a tough and hardwearing metal, able to withstand heating to high temperatures. It is commonly found in pre-industrial weaponry and armour, and a wide range of domestic fixtures from fireplaces to railings.

**Where was iron ore mined and produced?**
Iron has been in production for thousands of years, with the “Iron Age” occurring at different times in different civilisations. Iron taken from fallen meteorites was used as early as 4000 BC in Egypt. In Britain, there is evidence for the working of iron from around 700 BC.

Early iron furnaces were fuelled by charcoal. The industrial revolution in the late 1700s saw many improvements to furnace technology to switch from charcoal to coal or coke; many of these technical developments occurred around the major iron making areas of the West Midlands (particularly Coalbrookdale). Iron and steel production subsequently formed an essential part of the manufacturing economy of many areas of the UK. Some of the most significant areas of iron and steel making from the 19th to the mid 20th centuries include Cleveland (Redcar), South Yorkshire (around Sheffield), South Wales (Ebbw Vale, Merthyr Tydfil), the Derwent Valley (Consett), Weardale, and much of lowland Scotland around Glasgow (Coatbridge, Clydebridge, Motherwell).

**Wrought iron**
This is the oldest form of iron, which has been in use for some 4,000 years. The iron is heated in a furnace until soft and then worked by hammering or rolling – typically by a blacksmith.
By the 13th century in Europe, wrought ironwork was highly sophisticated. It was used for architectural features such as hinges, gates, grills and locks, as well as tools, weapons and armour, and domestic items such as candelabra and andirons.

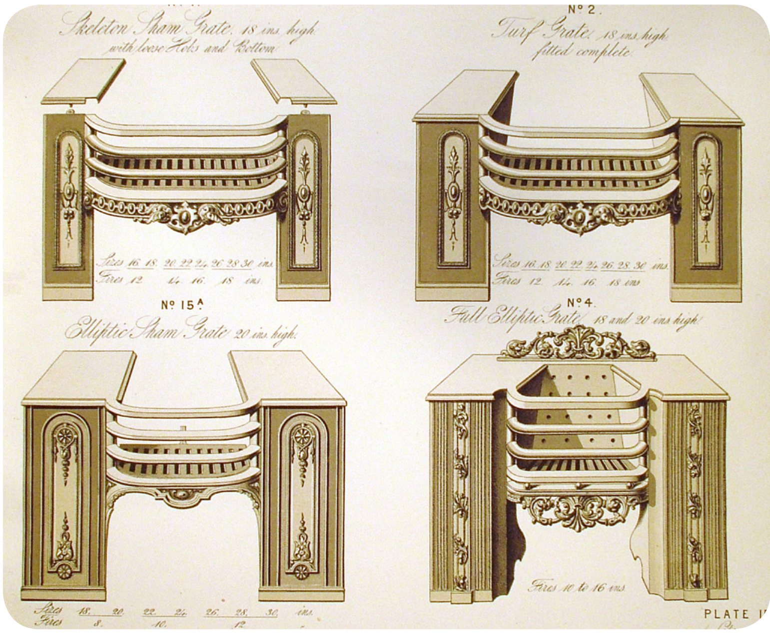
**Cast iron**
Cast iron contains between 2-4% carbon. It is produced in blast furnaces. It is stronger than wrought iron, but also more brittle. It cannot be forged or mechanically worked, but can be heat treated to harden. It may have a rough surface, looking coarser than wrought iron.


**Cast iron bell from the Swansea House of Industry, a workhouse.**
*© Swansea Museum*

**Clue:** There is one item of cast iron in the box.
It has a rough surface, which indicates that it was cast in sand.

Before the 18th century, cast iron was used principally for cannon balls, guns and fire-backs. The construction of the first cast iron bridge at Coalbrookdale in 1778 heralded its widespread use in the 19th century for buildings. It is found extensively in supporting columns in markets, railways, warehouses and even museums, as well its widespread use in the first half of the 19th century for architectural decoration and ornament. Externally it is found in street signs, lamp posts, bollards and railings while indoors it is found in radiators, doorstops, grates, cooking ranges and fireplaces. From the 1880s onwards, cast iron started to fall out of fashion, particularly for the more extravagantly decorative architectural uses.

**Cast iron construction in the Royal Scottish Museum, Edinburgh.**




**Page from a Falkirk Iron Company Trade Catalogue.**
© Beamish the North of England Open Air Museum

Although quite rare, 19th century manufacturers' catalogues can be used for identifying and dating cast ironwork. Many products were stamped with the manufacturer's trademark. Firms like the Carron Company, operating near Falkirk, and Walter Macfarlane & Co, in Glasgow, exported all over the Empire.

## 4.2 Steel

Much of what we assume to be iron is in fact steel, an alloy of iron and carbon. 'Mild' steel, which is low-carbon, was manufactured on a large industrial scale from the mid-1800s.

**Appearance**
Steel is also silvery-white, and can appear highly polished.

**Properties**
Like iron, steel is usually easy to identify because it is magnetic. It is extremely tough and hardwearing; the higher the carbon content in steel, the harder the metal will be.

**Clue:** There are three items of steel in the box. One is easily identified by a mark. The other two are recognisable from the evidence of corrosion.

**Iron and steel corrosion**
A stable oxidised iron surface will be compact and blue/black or red/brown in colour. When it is actively corroding, a rusty red/orange powdery corrosion product is visible, either as flaking fragments of iron, or depressions over the surface or pits with orange powdery spots in the middle.

At RH over 55%, it can also sweat or weep with yellow-brown droplets on the surface. At a lower RH, the droplets desiccate to leave blisters.

**Steel corrosion on Anthony Caro's 'Dream City' (1996) in the Yorkshire Sculpture Park, showing surface pitting and blistering.** © Zelda Baveystock

## 4.3 Stainless steel

Stainless steel is a generic name for steel alloyed with chromium, or chromium and nickel to prevent corrosion. There are over 150 different grades of stainless steel, depending on the proportions of chromium, nickel and other elements.

**Appearance**
Stainless steel is silvery grey. It can be highly polished, or can be burnished to leave a pale matt finish.

**Clue:** There is one item of stainless steel in the box, which is easily identifiable from the maker's mark. Its finish is typical of burnished stainless steel.

**Properties**
Stainless steel is highly resistant to corrosion. It is versatile and can be milled into sheets, bars, plates, wire and tubing. It is relatively inexpensive, which means it is found extensively in cookware, cutlery, jewellery, watches, surgical instruments and a wide range of industrial equipment and appliances. It is also used as a building material in tall buildings, bridges and landmark sculptures.

**Where was stainless steel made?**
Harry Brearley in Sheffield is popularly credited with inventing stainless steel in 1913. However, earlier experiments had been conducted in France, Germany, England and the USA – so like many grand inventions, the precise moment of discovery is not clear cut. Nevertheless, Sheffield and South Yorkshire became the principal area for stainless steel manufacture in England.

**Stainless steel corrosion**
As its name suggests, stainless steel does not corrode or rust as easily as ordinary steel. Corrosion is also less visible, and is unlikely to be detectable to the naked eye in most ordinary stainless steel objects. However, pitting and stress corrosion can occur in extreme circumstances (e.g. very high temperatures, extended exposure to salt water, or absence of oxygen). Active examples of corrosion are therefore unlikely to be found in the average social history collection!

## 4.4 Tin and its alloys

**Appearance**
Tin is a silvery white metal, which sometimes has a yellow tinge.

**Properties**
Tin is non-tainting, non-toxic and corrosion resistant. It is commonly used as a coating for cooking vessels or containers, and was found in foil form as a wrapper (e.g. chocolates and cigarettes) until the introduction of aluminium foil after 1910.

Pure tin is soft and relatively expensive as a metal. Much of what we consider to be tin is actually tinplate: a thin steel sheet covered with an even thinner layer of tin. Tinplate is therefore magnetic. The process of coating tin onto another metal is called tinning.

**Clue:** There are four items containing tin in the box, which will all be magnetic. They are lighter in weight than the iron or steel, but heavier than aluminium or zinc.

Tin has a low melting point and is often used as a solder, either on its own, or alloyed with lead.

**Where was tin mined and produced?**
Tin is thought to have been mined in Cornwall as early as the Bronze Age (2500 BC). Industrial scale mining peaked in the late 18th and 19th centuries. By the 1850s there were as many as 133 mines producing tin in Cornwall, which were responsible for 40% of the world's tin output. Cornwall and the west of Devon were the only areas in the UK to have significant tin deposits.

Tinplate manufacture was also dominated by the UK for most of the 19th century, with factories particularly in the West Midlands and South Wales. Indeed, the process of tinning an iron can as a container for food was first patented by an Englishman, Peter Durand, in the early 19th century. In the 20th century, UK production declined and was overtaken by the USA.

**Tin corrosion**
Tin is relatively resistant to corrosion. It rapidly forms a thin layer of tin oxide, which protects the tin underneath and maintains the bright appearance of the metal. In time tin may form a dull grey or black surface.

## 4.5 Britannia metal

Britannia metal is an alloy of tin and antimony, sometimes also including copper. It is not to be confused with Britannia silver, which is identifiable by its hallmark of the figure of Britannia. Britannia metal is most commonly found as a base metal for silver plating, and can sometimes be identified by the stamp 'EPBM' (Electroplated Britannia Metal). As EPBM cannot be identified by the magnet test, it is covered in more detail in section 6.4, on p. 21).

## 5. Test 2: Is the metal a yellowish, gold or pinky colour?

**If yes, it is likely to be gold, copper or an alloy of copper, like brass or bronze.**

## 5.1 Gold

**Appearance**
Gold ranges in colour from bright orangey-yellow to pale yellow. White gold is the term used for a pale grey alloy of gold and silver, nickel or palladium. Rose gold, pink gold or red gold is an alloy of gold and copper, which as its name suggests has a pinkish tinge.

**Properties**
Gold is a heavy but soft metal, which is highly malleable. Its rarity has resulted in it being one of the most highly valued of the metals, used for luxury decorative items, jewellery and coinage.

**Where was gold mined?**
Very minimal deposits of gold have been found in the UK, particularly in North Wales and parts of Scotland, but gold mining has never been a significant British industry. The discovery of gold caused notable waves of migration or 'gold rushes' in 19th century America, Australia, Argentina, Brazil, Canada, Chile and South Africa. Today South Africa is the top producer of gold, followed by Australia and the USA.


**White gold sweetheart brooch set with diamonds and in the shape of the Victoria Cross. Captain Augustus Agar VC (active 1919-1957) had the brooch made for his second wife as a gift.**
© National Maritime Museum

**An Edward IV gold coin showing the archangel St Michael piercing a dragon with his spear.**
© National Maritime Museum

**Gold hallmarks**

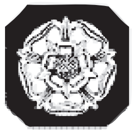
The simplest way to identify gold is through hallmarks. This box contains Bradbury's Book of Hallmarks which can help you, but there are many other similar books and websites you can use.

Since 1300, all gold items made in the UK must by law be sent to an Assay Office for testing and hallmarking. Today, there are four Assay Offices in Britain: in London, Sheffield, Birmingham and Edinburgh. In the past several larger cities such as Newcastle, Dublin, Glasgow and Exeter also had Assay Offices. Each Assay Office has an individual stamp, which makes up one element of the hallmark.

The gold hallmark consists of 5 stamps, usually in a line:

- The maker's mark (usually initials)
- The Assay office mark:

**London: Lion's Head**



**Sheffield: Rose**

**Birmingham: Anchor**

**Edinburgh: Castle**

- The date letter which denotes the year the piece was assayed
- The standard mark which gives the purity or the gold content

**Gold plate**

Due to its high cost, gold objects are often gilded with a thin surface layer of gold rather than being solid gold. Gold plated objects are often identifiable by wear to the plating leaving the base metal to show through.

There are several methods of plating used:

- **Gold Leaf** is made by beating pure gold into thin sheets. It is then applied as gilding to wood, metal or gesso. It is generally found on picture frames and furniture. It can sometimes be detected by areas of flaking which reveal the base beneath and the red or yellow bol used to apply it.
- **Mercury Gilding.** This has a matt appearance but can be burnished to a shiny finish. The process was highly toxic as it involved burning an amalgam of mercury and gold, to fuse the gold to the surface. It was superseded by electroplating in 1840 and is now illegal.
- **Electroplating** deposits a very thin layer of gold onto a base metal. It is found in cheap imitations of decorative items.
- **Rolled Gold** is another method of producing cheap gold jewellery, in use since 1817. A base metal sheet of silver, nickel silver or a type of brass called gilding was rolled between two thin sheets of gold and then made into decorative items.
- **Silver Gilt** is used for more luxury decorative items. The object is made of silver then electroplated with gold. Silver gilded objects are identifiable because although gold in appearance they must bear a silver hallmark. In some cases wear to the plating will be observed with the silvery surface showing through and / or silver tarnish.

## 5.2 Copper and its alloys

Copper has been used by humans for longer than any other metal apart from gold. It has been a major industrial metal since the mid-1800s, and forms the base for a wide range of alloys.

**Appearance**
Pure copper is a pinky (salmon) red. Its alloys range in colour from reddish yellow, to gold, to pale yellow, to white.

**Clue:** There is one item of copper in the box, which can be identified by its colour alone.

**Properties**
The most important property of copper is that it is a good conductor of heat and electricity (exceeded only by silver). A common use was therefore in cooking vessels, although the insides of copper cooking pots were often tinned as copper is toxic and taints food.

It is also the preferred material for power cables and a wide of range electrical equipment.

**A child's miniature gas cooking stove with brass feet, doors and handles, and copper cooking pans.**
© Beamish the North of England Open Air Museum

**Where was copper mined?**
The UK was a principal producer of copper in the 19th century, peaking just before 1850 with nearly half the world's output. Mines were found in Cornwall, Devon and South Wales, and are an important part of the industrial story of these regions.

By 1900, North America dominated production, with Russia, Japan and Chile also producing substantial amounts. Today, mines are found all over the world, including significant operations in Australia and several countries in Africa.

**Copper corrosion**
Copper has a relatively high resistance to atmospheric corrosion, although it will quickly tarnish in air to a red/brown colour. Sulphur in the atmosphere can be particularly harmful, producing a black film of copper sulphide.

Light corrosion on copper will be a stable, compact patination which is red or brown in colour. Heavier corrosion products range from pale / dark green through to blue green and black.

In architectural features such as copper domes, it takes about 10 years for the green patina to develop. This patina is in fact protective.

Copper is likely to corrode in wet acid environments e.g. in acid mine water, and is therefore not a suitable metal for mining equipment. But it is resistant to many soil constituents, apart from clays and loam, so can be preserved well in archaeological findings.

## 5.3 Brass

Brass is an alloy of copper and zinc (up to about 40%). Different proportions of zinc and other additives will alter the softness of the finished brass, and its resistance to corrosion.

Brass objects are usually cast, but flat plate can be used. Brass can be joined by silver soldering or brazing.

**Appearance**
Brass is a yellowish gold colour.



**Brass inclining dial, c.1737. This square shaped dial has a brass base-plate, a compass and two brass spirit levels.**

**Clue:** There are at least two items of brass in the box, which can be chiefly identified by their colour. A third piece contains some brass – or it maybe bronze.

**Properties**
Brass has a good resistance to water corrosion, including salt water corrosion, so it (and other copper alloys) are commonly found in domestic plumbing equipment, marine fittings and equipment, and industrial equipment where large quantities of water are required (e.g. papermaking, printing, air conditioning equipment).

Its malleability and its acoustic properties make it ideal for a wide range of musical instruments.

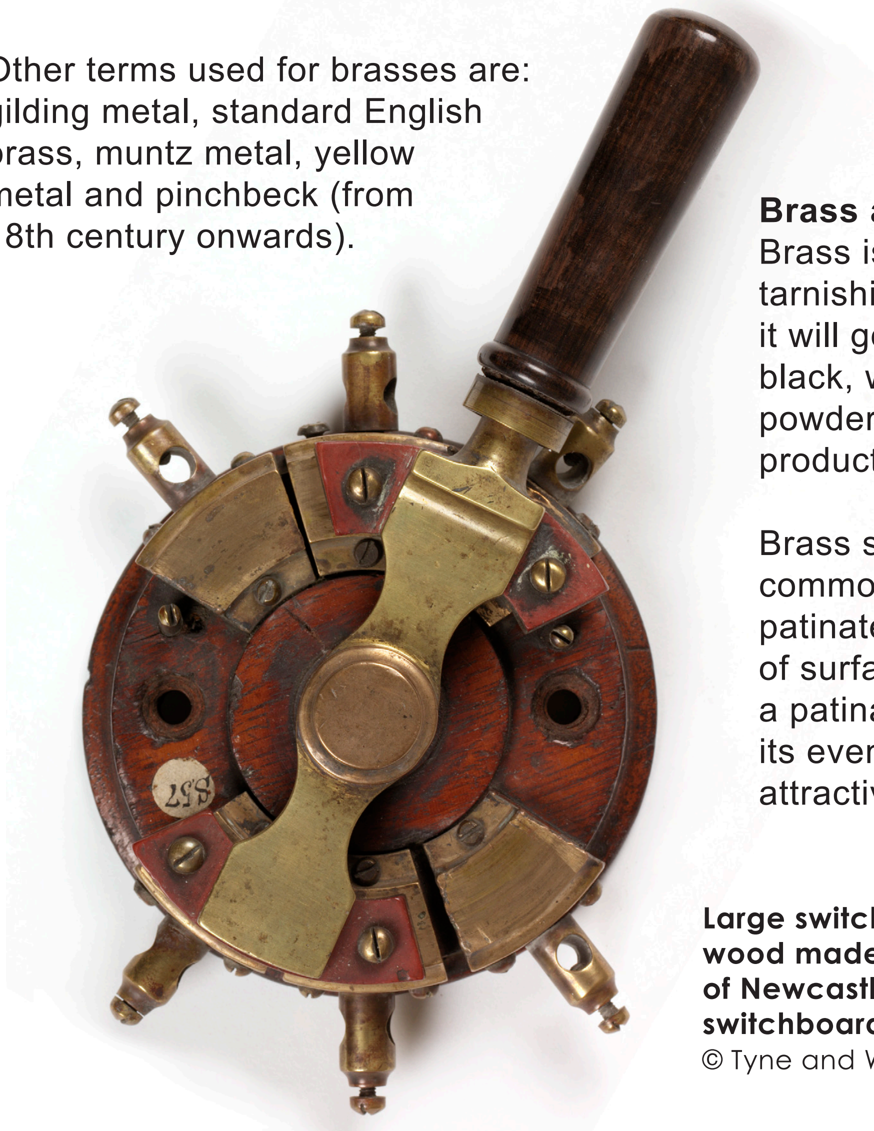
Some brasses can be heat treated to become memory alloys. This means that they revert to their initial form when at that temperature - a feature which is likely to be used in springs and control systems.

Cast brass with tin added (up to 1.5%) is known as **naval brass** or admiralty brass. It has enhanced resistance to sea water corrosion, and is therefore found in marine and scientific instruments.

Other terms used for brasses are: gilding metal, standard English brass, muntz metal, yellow metal and pinchbeck (from 18th century onwards).

**Brass and corrosion**
Brass is relatively resistant to tarnishing. When it does tarnish, it will go from brown through to black, with dark to bright green powdery or waxy corrosion products.

Brass scientific instruments are commonly lacquered or chemically patinated to produce a variety of surface finishes. You can tell a patina apart from corrosion by its even spread, and generally attractive appearance.




**Large switch of brass and wood made by J. H. Holmes of Newcastle for use on switchboards.**

## 5.4 Bronze

Bronze is an alloy of copper and tin (up to about 10%). Changing the amount of tin and introducing other metals alters the properties of bronze to suit different working conditions. It is a heavy metal which is generally cast, but can also be wrought. It is typically used for statuary, bells, sculptures and architectural castings.

Bronze with different proportions of added zinc is known as bell metal and **gun metal**. Gun metal is typically used in coins.

High tin bronze or **speculum metal** copper has a high proportion of tin (up to 28%), producing a white bronze which can be polished to a mirror finish. It is used in telescope mirrors. High tin bronzes are very brittle.

**A telescope mirror of speculum metal, c.1800**
© National Maritime Museum

Aluminium bronzes (copper + aluminium + iron, manganese, nickel) have a high level of mechanical strength and toughness, as well as a reasonable resistance to corrosion. They are found in cast forms in marine propellers and large valve components.

**Clue:** There are two pieces of bronze in the box. They have a more 'mellow' tone than the bright yellow of brass.

**Bronze and corrosion**
Bronze will corrode like copper, with green powdery or waxy corrosion products.

Bronze disease is an active and advanced form of corrosion found on archaeological bronzes. It appears as a warty eruption over the surface of the object. In relative humidity over 55% this may include sweating and weeping, resulting in extensive and rapid damage. Objects in this state require the attention of a conservator.

Bronze sculptures and statues are usually chemically patinated. These range in colour from dark browns/ greens to red browns. The patina is generally stable and protective as it acts as a barrier between the metal and the atmosphere.

**Typical bronze patination on a Henry Moore statue in the Yorkshire Sculpture Park.**
© Zelda Baveystock

## 5.5 Nickel silver

Nickel silver is an alloy of copper with zinc and nickel. As it is silvery grey in appearance, it is covered in more detail in section 6.3: see p.20. However, it is important to remember that despite its name and appearance, it contains NO silver.

## 5.6 Cupronickel

Cupronickel is an alloy of copper and nickel (up to 30%), sometimes with added iron.

**Appearance**
Cupronickel is silvery grey.

**Properties**
Cupronickel has very good resistance to corrosion and tarnishing. It is most commonly found in coinage and medals: most modern low denomination silver coins are in fact made of cupronickel. Its high resistance to salt water means that it is also found in marine equipment and power station condensers.

# 6. Test 3: Is the metal silvery with a hallmark, touchmark or maker's mark?

**If yes, it may be silver, pewter, electroplated nickel silver, or Britannia metal.**

(see also the section on stainless steel on page 8)

## 6.1 Silver

**Appearance**
Silver is a highly lustrous white metal. Like most metals, it is rarely found in pure form: most items that we recognise as silver are in fact alloys.

**Properties**
Silver's attractive, shiny appearance, its malleability and ductility have lead to it being highly prized for a wide range decorative items, tableware, jewellery and coinage.

It is the best conductor of heat and electricity of all the metals, and is used in many electrical applications, including switches, contacts and fuses.

Its highly reflective nature also leads it to be used in mirrors and in coatings for glass.

**Where was silver mined?**
Silver deposits are frequently found alongside those of lead, so the two mining industries are intertwined in the UK. Significant quantities of silver were extracted from the lead mines of Devon and Cornwall, mid and north Wales, North Yorkshire, Northumberland and Durham, the Isle of Man, and scattered mines in Scotland. All of these workings were exhausted or closed by the turn of the 20th century.


**US half-dollar coin, silver, 1976, showing the head of President John F. Kennedy.**

**Britannia silver**
This is the highest grade of silver, containing 95.8% silver. It is stamped with the figure of Britannia seated with trident and shield. It should not be confused with Britannia metal (an alloy of tin – see page 9).

**Sterling silver**
Sterling silver is the most common silver alloy, which contains 92.5% silver and 7.5% copper. It is tougher than pure silver, so it is used to make cutlery and other decorative tableware. It is most easily identified by its hallmark of four stamps:

- The maker's mark
- The sterling silver standard mark or Lion Passant
- Assay office (the same as gold)
- The date letter

An additional mark is found on pieces assayed between 1784 and 1890. This is the Duty Mark and was the monarch's head, either George III or Queen Victoria. Duty was payable on silver between these dates and the mark was proof that payment had been made by the maker. It would otherwise be considered illegal.


**These marks show that this piece was made by Samuel Hennell (the SH maker's mark), in sterling silver (the lion passant), in London (the crowned leopard), in 1811 (the letter Q). The monarch's head shows that duty had been paid.**


**Silver plate**
As with gold, silver objects are often covered with only a thin surface layer of silver rather than being solid. Silver plated objects are often identifiable by wear to the plating leaving the base metal to show through..

There are several methods of plating used:

- **Silver Leaf** is applied to a base metal in thin sheets.

- **Close Plating** was used from the 14th century to plate silver onto iron. It was used for small items such as knife blades and buckles. The iron was first dipped into molten tin. Silver foil was then applied and sealed with a hot iron. It is easily identifiable by the magnetic base metal, presence of iron corrosion or flaking to the silver foil revealing the tinned surface beneath.

- **Old Sheffield Plate** was a method of plating silver onto copper, invented by Thomas Bolsover of Sheffield in 1742. From 1784 it carried a maker's mark. In the early days of its production the copper would only have silver on one side and would be tinned on the other. Several methods of disguising the copper exposed on cut edges were used at different times, which can assist with the dating of pieces. The industry died out with the introduction of electroplating.

- **Electroplating** was used from the 1840s onwards, similarly applying a very thin layer of silver to a base metal. Common types of electroplated silver include EPNS (Electroplated Nickel Silver), produced between 1840s-1950s (see p.20) and EPBM (Electroplated Britannia Metal – see p.21). Less common types include EPC (Electroplate on Copper) and EPWM (Electroplate on White Metal). Each of these can best be identified either by stamps or marks, or by examining wear to the plating to see the base metal underneath. There are examples of both EPNS and EPBM in the box.

## 6.2 Pewter

Pewter is the most common alloy of tin and lead (about 4% lead) along with other additives such as antimony, which strengthens it. Since 1974, European pewter contains no lead at all.

### Appearance

Pewter is a soft silvery colour, which patinates over time to a stable dull grey. It can be polished to be silvery and shiny, and so it was used as a cheap silver substitute until the 19th century. (After this time silver substitutes are more likely to be made of Britannia metal - see section 6.4).

### Properties

Pewter has a low melting point which makes it suitable for casting. It was generally used to make a wide range of vessels and tableware (plates, dishes, tankards etc) often known as flatware. Cast wares are often identifiable by the solder joints where two cast halves have been put together.


**Pewter tankard made by James Dixon & Sons, Sheffield, 1890.**
© National Maritime Museum

**Pewter hallmarks and touch marks**
Pewter can bear a wide variety of marks, including hallmarks, touch marks, quality stamps, manufacturer's labels and catalogue numbers. The easiest to identify is the touch mark, which is stamped in relief (i.e. it stands out on the surface of the metal, unlike hallmarks which are stamped into the metal). They normally give the details of the maker and place of origin, and may include the words 'London' or 'Super Fine', sometimes with a crown. After 1878 the monarch's initials would be stamped beneath the crown. If a touch mark includes a date, this is the date the pewterer set up in business, and not the date of the object.

**Clue:** There is one item of pewter in the box, easily identified by the mark on the base.

For a fuller identification, you will need to refer to one of the books listing pewter touch marks. A good starting place is the website of The Pewter Society: www.pewtersociety.org. If you get really stuck, the Pewter Society also offers an identification service, if you can send them a good photograph of the mark.

## 6.3 Nickel silver (EPNS)

Nickel silver is an alloy of copper with nickel, often also containing zinc and/or a number of other trace metals such as antimony and cadmium. Despite its name and appearance, it contains NO silver.

**Appearance**
Nickel silver in prime condition could be mistaken for silver with a yellowish tinge. A high zinc content gives it a greenish tinge, while a low zinc content gives it a slightly pink cast.

**Properties**
Nickel silver is relatively cheap, and can be formed into a wide range of products. It is most commonly found as a base metal used for plating silver onto. Electroplated Nickel Silver was produced between 1840s-1950s for all sorts of decorative items and tableware. It can be most quickly identified by the mark 'EPNS'. If no mark is present, it can also often be identified by wear to the silver plating revealing the nickel silver with a yellowish tinge underneath.

**Clue:** There are two items of EPNS in the box. One can be identified by the 'EPNS' stamp. The other shows the classic yellowish tinge of nickel silver, where the silver plate has been entirely worn away.

After 1910, **chrome plated nickel silver** (CPNS) was also produced. This has a silver coloured coating of chrome rather than real silver. It is distinguished by its hard shiny surface which has a bluish tinge when highly polished.

**Nickel silver and corrosion**
The high copper content of nickel silver means that green copper corrosion products will be found when nickel silver corrodes.

## 6.4 Britannia metal (EPBM)

Britannia metal is an alloy of tin and antimony, sometimes also including copper. It is sometimes also known as Queen's metal. It should not be confused with Britannia silver, the highest grade of silver which is identifiable by the hallmark of the figure of Britannia seated with a trident and shield.

**Appearance**
Britannia metal is silvery grey in colour.

**Properties**
Britannia metal is strong, hard and highly resistant to corrosion. It is extremely versatile, and can be cast, spun, die stamped and lathe turned. Because of these properties, it took over from pewter for use in tableware from the mid 1800s.

Britannia metal's widest use is as a base metal for silver plating. This is often identifiable by the stamp EPBM (Electroplated Britannia Metal). It was extremely common in the late 19th century for cutlery and other household goods. It is less durable than EPNS, but was cheaper to produce.

**Clue:** There is one item of Britannia metal in the box. The silver plating has been almost entirely worn away, so the surface of the object is typical of the colour of Britannia metal.

# 7. Test 4: Is the metal silvery - grey, but with no identification marks?

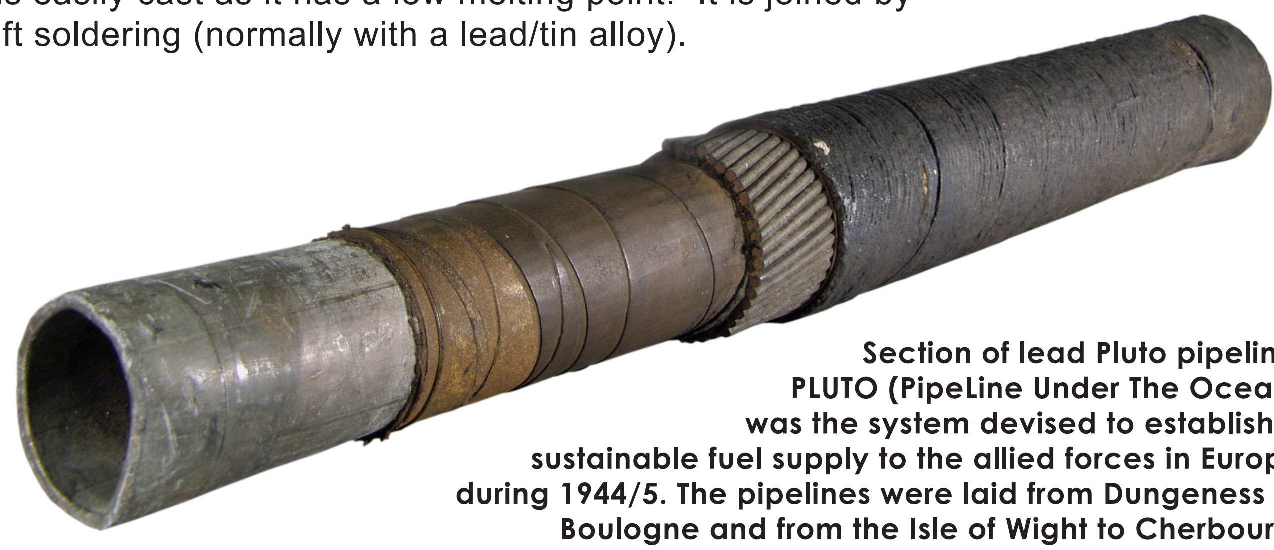
**If yes, it may be lead, zinc, aluminium or chromium.**
(see also section 6.3 on EPNS and 6.4 on EPBM on p.20-21)

## 7.1 Lead

**Appearance**
When fresh, lead is a silvery blue colour. However, it oxidises quickly in air to produce a dull matt grey colour, by which it is more normally recognised.

**Properties**
Lead is a soft metal. It is generally stable and is often used in architectural features, particularly roofing, window leading and cast as guttering and drainpipes.

It is easily cast as it has a low melting point. It is joined by soft soldering (normally with a lead/tin alloy).



**Section of lead Pluto pipeline. PLUTO (PipeLine Under The Ocean) was the system devised to establish a sustainable fuel supply to the allied forces in Europe during 1944/5. The pipelines were laid from Dungeness to Boulogne and from the Isle of Wight to Cherbourg.**
© Swansea Museum

**Where was lead mined?**
Lead mining has occurred in Britain at least since Roman times. Medieval production and technical expertise was found principally in Germany. By the 18th and 19th centuries, the UK was the world's largest producer of lead. Significant mines were found in Wales (around Wrexham), Derbyshire (Peak District), Yorkshire (Swaledale), the North Pennines (Weardale, Tynedale, Teesdale and the Derwent Valley), Cornwall, Somerset and Devon and south west Scotland (around Wanlockhead).

Foreign competition, particularly from Spain, but also from Germany and America, resulted in the collapse of the British lead mining industry in the late 19th and early 20th century.

**Lead corrosion**
Lead corrosion is powdery and white, and can appear 'warty' in an advanced state.

**Clue:** There is an item of lead in the box which can be identified by its weight, plus the evidence of white lead corrosion (lead carbonate).

Lead is particularly susceptible to organic acid vapours given off by wood, especially oak used in storage units. Felt is also particularly harmful to lead, and should not be used as a packing or mounting material.

## 7.2 Zinc and its alloys

**Clue:** There is one item of zinc in the box, which is in the form of a sample of the metal only.

**Appearance**
Zinc is a silvery white metal.

**Properties**
Zinc's most important property is its high resistance to atmospheric corrosion. Its most common usage is as a coating to protect steelwork.

In its pure form, zinc is stronger and harder than tin or lead, but weaker than aluminium or copper. It has a tendency to be brittle at ordinary temperatures, and because it has a relatively low melting point (419°C), it is not used much in engineering applications. It can be rolled, and is used widely in mainland Europe as a roofing material.

Its strength and hardness is increased considerably as an alloy, where it is used in both die-casting and moulding.

**Where was zinc mined and produced?**
Smelting of zinc is technically very difficult, so there is little evidence of its production before the 14th century (although it is found as a component in brassmaking centuries earlier). The earliest archaeological evidence of its production is at Zawar in Rajasthan, India.

The first commercial plant to produce metallic zinc in Europe was built by William Champion in Warmley, near Bristol, in the 1740s, by adapting a furnace already used for making glass. Champion was declared bankrupt in 1767, so it is unlikely his pioneering work was a great success. In the 19th century, Silesia was the centre of production, and in the 20th century the development of the electrolytic process shifted production to the US. In the UK, significant production in the 20th century centred around Swansea and Avonmouth, with major producers including the Imperial Smelting Corporation and the National Smelting Company.

Today, much of the world's zinc originates in Canada, USA, Mexico and Australia.


**Swansea was the principal zinc producer in the UK. By 1922 there were six zinc-smelters in operation in the lower Swansea Valley, including the Imperial Smelting Corporation Works in Llansamlet, from where this ingot originates.**
© Swansea Museum

**Zinc alloys**
Zinc is most commonly alloyed with aluminium, and then used as a coating over steel to protect it from corrosion. Zinc coatings are applied by **galvanising** (dipping in bath of molten zinc or electroplated), metal spraying (used in situ for large structures like bridges) or through zinc dust paints. It is therefore found on nuts, bolts, screws and buckets, as well as large supportive structures like steel cables.

**A zinc-aluminium** alloy is used for die-casting. Typical items made by this method are small toys such as Dinky toys. Trademark names for this alloy include Zamak and Mazak, and it is also known as **pot metal**. Early 20th century die-casting often cracked or decomposed due to metal fatigue, so toys pre 1940s will often be in a poor condition.

A **zinc-titanium** alloy is used for zinc sheeting, commonly found as a roofing material, and also as the casing for dry batteries.

Zinc is also alloyed with copper to form **brass** - see section 5.2 on copper.

**Zinc oxide** is a white pigment which is used extensively in the rubber, ceramic and paint industries. As it absorbs ultra-violet light, it is also found in many suntan lotions and cosmetics.

**Zinc and corrosion**
As one of zinc's main properties is its resistance to corrosion, it is unlikely to present significant problems in museum collections.

## 7.3 Aluminium and its alloys

**Appearance**
Aluminium is a bright silver-coloured metal. It is paler in colour than the other silvery metals.

**Properties**
Aluminium is a light metal, with about a third of the density of steel or brass. It is a good conductor of electricity and heat, and has a high resistance to atmospheric corrosion.

Aluminium is also soft. It is too soft to have many uses as a pure metal, except when in foil form.

**Where was aluminium mined and produced?**
Although aluminium is the most plentiful of the metals, making up about 8% of the earth's crust in mineral and compound forms, it is technically difficult to extract. Today it is principally extracted from bauxite, which is mined in quantities in Australia, Brazil, Guinea, Jamaica, Russia and Indonesia.

Production of aluminium was not commercially developed until the late 1880s, with the development of the electrolytic process in France and the USA. Smelting aluminium requires large amounts of electricity, so the greatest producers are those countries with access to low cost hydro-electricity – such as Canada, USA, Russia, Norway and Switzerland. The aluminium smelting industry in the UK was in comparison tiny, centring mainly around the Scottish Highlands and Dolgarrog in North Wales. Today there are still operational smelters at Lynemouth in Northumberland and Lochaber in the Highlands.

**Aluminium alloys**
Aluminium is normally alloyed with copper and/or magnesium, silicon, zinc and manganese. These alloys can be extremely high strength, but still light in weight compared to steel. The alloys are also highly versatile. They can be cast – as is often found in aircraft parts – or wrought into sheets, rods, bars, wires or foil. They can also be heated treated for extra strength.

Common uses of aluminium alloys include food and drinks cans, aircraft fuselages, car parts and wheels, and shipping superstructures (after the 1950s). It is impossible to tell the precise consituency of an aluminium alloy without destructive analysis.

**Clue:** There are two aluminium alloy objects in the box. Both are comparatively light in weight, and one has a function which requires considerable strength.

**Aluminium and corrosion**
When exposed to the atmosphere, aluminium corrodes very quickly to form a layer of aluminium oxide. This surface layer of oxidisation is both stable and protective, thus preventing any further corrosion. This is why aluminium is both highly corrosive and yet simultaneously considered to offer excellent resistance to corrosion.

## 7.4 Chromium (chrome)

**Appearance**
Chrome is a highly shiny, silvery metal. It has a harder, bluer appearance than silver.

**Properties**
Chromium is hard wearing and highly corrosion resistant. It is commonly found in a very thin layer (about 0.0003 mm) electroplated over nickel or other metal alloys, to produce cheap, shiny decorative items. Typical uses include belt and shoe buckles and zip fasteners.

Chromium is also added to steel alloys, to increase its hardness on heat treatment.

**Clue:** There is one item of chrome plating in the box. It can be identified by its high shine, and cheap mass-produced quality. The magnet test suggests that the base metal is tin.

# 8. Environmental Requirements

Metals corrode in moist environments. **Relative Humidity** is therefore the key factor to consider when caring for metalwork.

Generally as low a humidity as can be achieved is recommended for metal only objects up to an upper maximum of **55%RH.**

Iron corrodes at above 13%RH but maintaining this low a humidity in most instances is impossible. Maintaining a **stable** humidity with fluctuations ± 5%RH in any 24 hour period will significantly slow any deterioration. Copper alloy corrodes at above 35%RH and lead at above 40%RH.

Objects containing both metals and organic materials such as wood, bone, leather and ivory will be damaged at low humidities, as the organic elements will dry out and deteriorate. A stable **50% - 55% RH** is therefore acceptable for composite objects containing some metalwork.

If the RH moves above 70% organic material is at risk of mould growth. Problematic pieces like actively corroding archaeological metalwork should be stored separately so that the RH can be brought as low as possible without risk to organic materials. If you do not have access to a well-controlled, humidified store, small items can be adequately stored in an inert, sealed box containing silica gel for low humidities or Artsorb for mid range humidities where the object includes organics.

The ideal **temperature** is **18°C** with a maximum fluctuation of ±5°C maximum in any 24 hour period.

The maximum recommended **light level** for metals is **300 Lux** and 75μW/lumen. Where the metal object includes organic elements the maximum light level should be reduced to 50 Lux. The lower the light and ultra-violet light levels the slower any rate of deterioration will occur. Stores should be kept in the dark when not in use.

**Atmospheric pollutants** are a particular problem if your collection includes outdoor metalwork or your museum is in an urban environment. All atmospheric pollutants will help to promote corrosion. Some buildings have particle filters on air vents to keep pollutants out of the building. Well-sealed cases can also minimise the risk posed by atmospheric pollutants.

# 9. Storage and Display Materials

**Wood shelving**
Wood is unsuitable for metals in general, and should be avoided if possible, especially inside cases. Oak is especially harmful to lead and pewter.

Aged, seasoned, dry woods of species such as birch, mahogany or beech are acceptable for storage shelving, if unavoidable. Any wood product inside a case should be sealed using an aluminium barrier foil.

**Wood Panel Products**
Many wood panel products emit organic acids from the wood, and formaldehyde and acid from the adhesives. As it is impossible to know which woods have been used, interior grade plywood, interior grade particle board, chipboard, fibreboards, and unsealed MDF should all be avoided in shelving and case construction. Zero formaldehyde MDF is also harmful.

Plastic laminated panels can be used (non PVC based), or wood products can be replaced with powder coated metal, galvanised and stainless steel, glass or acrylic sheet. If wood panel products are used they must be totally sealed using an aluminium barrier foil.

**Paper & Cardboard**
Acid free paper or card produced to archival quality should always be used.

Archaeological metal in contact with paper or cardboard will deteriorate both the object and the paper / card. Small objects can be boxed in sealed airtight plastic boxes instead with either silica gel or pre condition Artsorb.

**Paints (for use in displays)**
Paint may release harmful vapours, which can be corrosive if they build up. All painted cases etc should be allowed to off gas with the door open for a minimum of one week and preferably one month prior to installation.

Acrylic emulsion, eggshell, two part epoxy systems, and powder coating can all be used safely. Water based emulsions are most likely to pass conservation requirements but about 10% of these fail.

Oil and alkyd paints, one part epoxy systems, chlorinated rubber paints, oil modified polyurethane varnish should be avoided.

**Sheet plastics**
Some plastics release volatile sulphides, nitrates and acetate when degrading, which further corrosion. PVC (polyvinyl chloride), vulcanised rubber, chlorinated rubber, cellulose nitrate, cellulose acetate should all be avoided. Bubble wrap should be avoided for wrapping metals if in direct contact with the surface of the metal.

PET (polyethylene terephthalate) which is commonly known as mylar or polyethylene can be used. Acrylics such as plexiglas, perspex polycarbonate sheeting, or Teflon (PTFE: polytetrafluoroethylene) are also acceptable.

**Foam and plastic/ foam boards**
Some foam boards degrade releasing volatile substances which will be corrosive. Polyester, polyurethane, neoprene, vulcanised rubber and PVC foam boards (e.g. Sintra, Gatorfoam) should all be avoided.

Plastazote (closed cell polyethylene foam), Ethafoam and corrugated plastic like Coroplast or Kortek can all be used safely.

**Adhesives & Tapes**
On ageing, unsuitable adhesives and tapes become brittle, yellow, tacky and acidic. Rubber in particular will emit sulphides, which tarnishes silver rapidly. Most epoxies, contact cements, natural / synthetic rubber cements, polysulphides and vinyl emulsions should be avoided.

Transparent acrylic tape (Scotch tape), starch paste, particular acrylics (paraloids), two part epoxies (Hyxtal NYL-1), PVA emulsions (Mowilith), ethylene / vinyl acetate copolymers (BEVA 371) and Evo-stik Impact 2 are safe. Animal glue may be used depending on the object and circumstances – consult with a conservator first.

**Textiles**
Sulphur-containing materials like wool, felt, velvet and rubber-backed carpet are damaging to silver and lead. Felt produces formic acid which is particularly harmful to lead. Certain textile dyes are volatile and should be tested prior to use. Even if you are re-ordering the same fabric from the same manufacturer dye components tend to change. It is recommended that fabrics are Oddy tested every three years because of this.

Unbleached cotton or linen, spun bonded or woven polyester (Reemay), woven spun bonded nylon, Velcro and Tyvek can all be used safely.

## 10. Cleaning metals

As with all cleaning of museum objects, every object must be assessed individually before proceeding with treatment. Always consult a conservator first, and make sure any cleaning done is fully documented and photographed.

With metals, it is particularly important not to overclean, as patinations are often historically important and original parts of the object. For example, gun barrels are often browned to cut out reflection when aiming and to enhance their appearance, but browning is often wrongly mistaken for iron corrosion and removed.

Always examine the object thoroughly under a microscope prior to treatment. You may find evidence of surface deterioration which was not apparent on visual assessment. Where possible cleaning and corrosion removal should be undertaken under a microscope or illuminated magnifier.

Special care must be taken with composite pieces. Any cleaning solution used on metal work must not come into contact with adjoining materials. All traces of cleaning solutions must be removed so that no residue remains on the object.

### 10.1 Cleaning silver

Removing tarnish also removes a layer of silver. Many silver plated objects have had the silver literally worn away with excessive cleaning – as can be seen with several of the items in the box. Over-cleaning can also lead to a loss of detail in engraving. All polishes are abrasive and care must be taken when using them to avoid scratching. General purpose metal polishes are too harsh for silver and should be avoided. If in doubt consult a conservator for advice before proceeding.

Very light tarnishing can be safely removed with a silver cloth. These are available from jewellers and conservation suppliers and are impregnated with a cleaning agent. They are more gentle than domestic silver polish. After cleaning, the surface should be thoroughly buffed with a lint free cloth or cotton wool, to remove any chemical residue from the silver cloth.

For heavier tarnishing, silver Duraglit wadding can be used. Wadding can be wrapped around cocktail sticks for swab cleaning. When the polish is dry it should be buffed gently with cotton wool or a soft cloth.

Liquid chalk based polishes should always be avoided, as they leave a residue in details and joints which is difficult to remove.

Once cleaned, further tarnishing can be minimised by storing or displaying the silver on boards lined with activated charcoal cloth, or by placing silver scavengers or tarnish inhibitor capsules in the case to absorb tarnishing gases. These can all be bought from museum conservation suppliers.

## 10.2 Cleaning copper and its alloys

As with silver, surface dirt and grease from handling may most simply be removed using a silver cloth. Be sure to buff the piece thoroughly afterwards with a lint-free cloth.

Copper alloys are often naturally or chemically patinated. These surfaces are an integral part of the object, and their removal may ruin the object by destroying its original surface. The advice of a professional conservator should therefore always be sought first. For example, the lacquers on scientific instruments are historically important and should be preserved rather than removed and reapplied.

Copper and brass polishes such as liquid Brasso should never be used as a cleaning agent. They contain ammonia, which will accelerate copper corrosion and cause de-zincification of brass. Chalk-based liquid polishes should also be avoided, as they leave a pale green residue which similarly accelerates corrosion.

## 10.3 Cleaning iron

Mechanical removal of corrosion under a microscope is the least damaging method for iron. It is sometimes advisable to x-ray an item first, to ascertain what details lie beneath the corrosion. Light corrosion can be removed with wire wool (0000 grade) and white spirit as a lubricant, while a blunt scalpel blade can be used for heavier deposits.

Three cleaning products which can be used with care are ‘Garryflex’ 240 grit, Solvol Autosol metal polish and Prelim metal polish. The Garryflex grit is like an eraser with fine abrasive particles. Prelim and Solvol Autosol can produce a more polished surface if required. Prelim is the least abrasive of the metal polishes and is the preferred product to use. Consult a conservator before carrying out any mechanical or solvent based cleaning of a metal surface.

## 10.4 Cleaning Lead

Lead corrosion salts are carcinogenic and should not be inhaled. Any removal of lead corrosion should be done using gloves and a dust mask in a well ventilated area and should be limited to swabbing with white spirit only. Consult a conservator.

For all metals, future corrosion can be guarded against after cleaning with a layer of renaissance microcrystalline wax, although this will not be effective if the overall environmental conditions are inappropriate. The renaissance wax can be applied using a soft brush and buffed using a lint-free cloth.

# Appendix 1
# Sources of further information and support

**Antique Metalware Society**
www.oldcopper.org/ams.htm
The society produces an annual Journal and newsletters for members. The website contains extensive further information and references for copper and brass in particular, although the society has much broader interests.

**Collections Link**
www.collectionslink.org.uk/special_collection/metals
Currently contains further guidance on the Treasure Act (England/ Wales, Scotland and Northern Ireland), the law pertaining to firearms, and advice on marking small objects such as coins, as well as links to ICON factsheets.

**firstBASE**
www.shcg.org.uk/firstbase
SHCG's online database of the most useful resources relating to all types of history collections.

**The Historical Metallurgy Society**
http://hist-met.org/index.html
Publishes newsletters and the journal, Historical Metallurgy, as well as holding study visits and conferences.

**The Institute of Conservation (ICON)**
www.icon.org.uk
ICON has a Metals Group of public and private sector conservators.
ICON also runs an online register of conservators:
http://www.conservationregister.com

**The Pewter Society**
www.pewtersociety.org
The Pewter Society offers a free service to museums to help them identify and catalogue their pewter collections correctly. The website also contains a useful section on identifying marks.

**Hallmarks:**
There are several websites which can help you with hallmark identification. Try the following:

www.925-1000.com for both British and American hallmarks

http://www.silvercollecting.com for American silver only

http://www.theassayoffice.uk.com has a database of early silver marks

# Appendix 2
# Further reading


**BRASS:**

**The Brass Book**
Peter, Nancy and Herbert Schiffer, Schiffer Publishing Ltd, 1978

**The English Brass and Copper Industries 1800-1926**
Henry Hamilton, Longmans,1926

**English Domestic Brass 1680-1810 and the History of its Origins**
Rupert Gentle and Rachael Field, Paul Elek, 1975

**An introduction to Brass**
Eric Turner, HMSO V&A “Introduction to Decorative Arts” series, 1982

**COPPER:**

**A History of Copper Mining in Cornwall**
Denys Bradford Barton, Tor Mark Press, 1978

**Art of Coppersmithing:**
**A Practical Treatise on Working Sheet Copper into All Forms**
John Fuller, Astragal Press,1993

**IRON:**

**Decorative Wrought Ironwork in Great Britain**
R. Lister, David & Charles, 1970

**Decorative Cast Ironwork in Great Britain**
R. Lister, Bell, 1960

**A History of Cast Iron in Architecture**
John Gloag and Derek Bridgwater, Allen & Unwin 1948

**Decorative Ironwork**
Marian Campbell, Harry H. Abrams, 1998

**STEEL:**

**The British Iron & Steel Industry: a technical history**
W. K. V. Gale, David & Charles, 1967

**The History of British Steel**
Baron John Ernest Vaizey, Weidenfeld & Nicholson, 1974

**SILVER:**
**Sotheby's Concise Encyclopaedia of Silver**
Charles Truman (Editor) Conran Octopus Ltd, 1996

**Silver**
Philippa Glanville, V & A Publications, 1997

**GOLD:**
**The World's Greatest Treasures:**
**Masterworks in Gold and Gems from Ancient Egypt to Cartier**
Gianni Guadalupi (Editor), Thames & Hudson, 1998

**TIN:**
**Tin Craft**
Fern-Rae Abraham, Sunstone Press, 1994

**A History of Tin Mining and Smelting in Cornwall**
Denys Bradford Barton, Cornwall, 1989

**PEWTER:**
**A History of British Pewter**
J. Hatcher and T.C. Barker, Longman, 1974

**British Pewter**
R.F. Michaelis, Ward Lock & Co, 1969

**LEAD:**
**The History of Lead Mining in the North East of England**
Les Turnbull, Ergo Press, 2006

**History of the British Lead Manufacturing Industry, 1778-1982**
D J Rowe, Croom Helm, 1983

**ZINC:**
**History of the Zinc Smelting Industry in Britain**
E J Cocks and B Walters, Harrap, 1968

**MISCELLANEOUS:**
**Modern Metals in Museums**
Robert E. Child and Joyce M. Townsend (Editors), Institute of Archaeology Publications, 1988

**A Diderot Pictorial Encyclopaedia of Trades and Industry**
Denis Diderot, Dover Publications Ltd, 1958 - A reproduction of 485 plates from "Encyclopedie, ou Dictionnaire Raisonne des Sciences, des Arts, et des Metiers"

*If you have found other books, journals, websites or other resources that you would recommend for the study of metals, add them to FirstBASE, SHCG's online database of reference materials. See www.shcg.org.uk/firstbase*

# Appendix 3
# Selected Museums and Heritage sites to visit

## Iron and Steel

**Mining & production:**

Coalbrookdale Museum of Iron, Coalbrookdale, Telford
Blists Hill Victorian Town, Madeley, Telford
Abbeydale Industrial Hamlet, Sheffield
Magna, Rotherham

**Objects:** Millennium Galleries, Sheffield
Gloucester Folk Museum, Gloucester
The Dock Museum, Barrow-in-Furness

## Tin

**Mining:** Geevor Tin Mine Heritage Centre, Penzance
**Objects:** Blists Hill Victorian Town, Madeley, Telford

## Copper, Brass and Bronze

**Mining and production:** Great Orme Bronze Age Copper Mines, Llandudno
**Objects:** Bate Collection of Musical Instruments, Faculty of Music, St Aldgate's, Oxford
Bewdley Museum, Bewdley, Worcestershire
British Museum, London
Carnegie Museum, Inverurie

## Gold

**Mining:** Dolaucothi Gold Mines, Llanwrda
**Objects:** Bank of England Museum, London
British Museum, London
Victoria and Albert Museum, London

## Silver

**Objects:** Aberdeen Art Gallery, Aberdeen
Grosvenor Museum, Chester
Millennium Galleries, Sheffield
Victoria and Albert Museum, London

## Lead

**Mining and objects:** Killhope North of England Lead Mining Museum
Peak District Mining Museum, Matlock Bath
LLywernog Silver-Lead Mining Museum, near Ponterwydd
Minera Lead Mines, Wrexham
Museum of Lead Mining, Wanlockhead
Museum of Yorkshire Dales Lead Mining, Earby

## Zinc

**Mining and objects:** Minera Lead Mines, Wrexham
Laxley Wheel and Mines Trail, Isle of Man

## Appendix 4
## Using the box as part of a one-day seminar

The contents of the box and the resources can be used as the basis of a wider one-day event, if you would like to deliver training to more curators in your region, or, for example, as a programme of basic collections care for volunteers and other non-curatorial staff.

The SHCG Seminars Organiser can offer advice on how to run a one-day event, and may be able to suggest contacts in your area for delivery. Below is a brief step-by-step guide of things you will need to consider. From experience, we recommend that one-day events accommodate no more than 25 people.

**Content and delivery of the event:**

- Consider who will deliver the day. Do you have conservation staff who would be willing to lead it? Or is there a local expert who could be bought in for a day?
- Consider whether you could add to the sample programme: are there any interesting and relevant conservation case studies or metal collections in your region? Is there an aspect of a local industry that you might wish to cover in more detail?
- Once you have identified who will deliver the day, fix a date according to their availability.
- A typical timetable might be:

| | |
|---|---|
| **10.00** | **Arrival and tea/coffee** |
| **10.15** | **Talk: the properties of metals** |
| **11.00** | **Break** |
| **11.15** | **Handling session: identifying items from the box** |
| **12.00** | **Lunch** |
| **1.00** | **Talk: Collections management and cleaning** |
| **2.00** | **Handling/ viewing session: additional items from your collections/ the local social history of metals** |
| **2.45** | **Break** |
| **3.00** | **Opportunity for delegates to bring own objects and discussion** |
| **3.50** | **Summary** |
| **4.00** | **Close** |

- Make sure that the speakers are briefed in advance on the content that you require and that they provide a handout or notes for delegates to take away.

**Organisation before the event:**

- Source and book a suitable size room. This will need sufficient chairs in lecture format, and space for up to four trestle tables for objects with room between them for people to gather around in small groups. You may also need to provide a data projector, screen and laptop depending on the speaker's requirements. A second space, or a clearly sectioned-off part of the room, will be needed if you intend to offer refreshments and lunch, to keep food and drink away from the objects.

- Consider accessibility issues before booking the room: will all delegates be able to use it, and get to an accessible toilet if needed?
- Cost the event. Consider the following possible expenses:
  - Room hire
  - AV equipment hire
  - Speaker's travel and lunch expenses (remember to ask them to provide a receipt). SHCG does not normally pay fees to speakers as this can make events too expensive for small museums to attend. However, a freelance expert may require some recompense for their time.
  - Refreshments and lunch for delegates. You can ask delegates to bring their own lunch if you are unable to provide this, but a tea or coffee and water is normally needed at some point!
- When you have assessed your expenses, you may have to consider charging a nominal fee for your event. Divide the total cost by the anticipated number of participants for a rough calculation of a break-even charge.

**Promotion of the event:**

- If you would like to promote your event to a wider audience, advertise on the SHCG website and email list. Your regional MLA may also have a news alert service.
- A sample booking form has been provided for you to distribute prior to your event with any advertising. An editable version is available on the CD in this pack, for you to adapt to suit your needs. Remember to ask delegates in advance if they have any particular access requirements. Be prepared for requests for information in alternative formats.
- Once people have booked, you will need to provide them with a programme for the day and directions to your venue.

**Organisation on the day:**

- Provide a participant sign-in sheet and name badges.
- Provide a delegate pack, containing the programme for the day, any handouts, and evaluation sheets (download from the CD in this pack)
- You will need to nominate a person to act as convenor on the day. Their role will be:
  - To welcome and register delegates.
  - To inform delegates of housekeeping/health and safety issues of the venue.
  - To introduce the speakers and sessions.
  - To facilitate discussion sessions.
  - To collect evaluation forms at the end of the day.

# Appendix 5
# Sample booking form

**The CD in this pack contains a version of this booking form in a word format, for you to edit to meet your needs.**

## Object Lessons 1:
### An Introduction to Metals

MUSEUMS LIBRARIES ARCHIVES

Social History Curators Group

This seminar will provide a hands-on introduction to the care and identification of metals. Drawing on handling resources provided by the Social History Curators Group, it will provide delegates with a basic understanding of how to identify and care for the types of metals most commonly found in social history collections. It will also explore signs of corrosion and deterioration in metals, with practical solutions for common collection management problems.

**Venue: (insert host venue here)**

**Date: (insert date of seminar here)**

**Time: (insert times of seminar here)**

**Cost (including lunch):** £ Members, £ Non-members

**LIMITED PLACES – BOOK NOW!** We expect this seminar to sell out quickly.

---

### Booking Form – Object Lessons 1: Metals

Name:

Organisation:

Address:

Tel: Email:

Are you a member of SHCG? Individual ☐ Institutional ☐ No ☐

Special dietary requirements:

If you have any access requirements, please give details on the reverse of this form or contact (insert name and details of organiser here)

I enclose a cheque for £________ made payable to (insert account name here)
Or
Please invoice ☐Purchase order no ___________

Please return the completed form and payment by (insert booking deadline here) to:
(insert name, address, and telephone number of seminar organiser here)

## Appendix 6
## Evaluation form

**Once you have finished using the loans box, it would greatly help SHCG if you could complete this evaluation form. Your comments will be used to help us plan future learning resources. You can photocopy this form, or print a copy off from the CD in this pack.**

# Object Lessons 1: Metals
## Evaluation Form

**1. Please rate the following statements:**

| | Strongly Agree | Agree | Neither Agree / Disagree | Disagree | Strongly Disagree |
|---|---|---|---|---|---|
| I have a better understanding of the basic material properties of metals. | | | | | |
| I have increased my understanding of the common uses of metals found in social history collections. | | | | | |
| I have increased my understanding of the care of metal collections. | | | | | |
| I have found new sources of information and support which might help me in the future. | | | | | |
| I have increased my ability of how to identify metal collections. | | | | | |
| I feel I will be able to document metal collections more accurately. | | | | | |
| I feel I will be able to identify signs of corrosion in metals. | | | | | |
| Using these resources has increased my confidence about working with metals in collections. | | | | | |
| I found the resources inspiring. | | | | | |
| I will use the information I have learned to help me interpret collections in the future. | | | | | |
| I would like to get more involved in SSNs or other specialist groups interested in metals. | | | | | |

2. **What was the most valuable part of the Object Lessons Resources?**

3. **How could we have improved these resources?**

4. **How did you use the resources?**

Self-directed learning………………….. ☐ Group seminar…………… ☐

Other (Please specify) ….. ☐ ……………………………………………….

5. **How long did you borrow the resources for?**

6. **What themes would you like us to consider for future handling resources?**

7. **Are you a member of SHCG?**

Yes………………………… ☐ No………………………….. ☐

8. **Any other comments or suggestions:**

**We would be grateful if you could take the time to complete this form. Please post your completed form to Zelda Baveystock, National Museums Liverpool, William Brown Street, Liverpool L3 8EN**

**Acknowledgements**

This pack was written by Zelda Baveystock, drawing extensively on the following publications:

Alexander, W. and Street, A. (1989) *Metals in the service of man*. London: Penguin

Betteridge, W. (1977) *Nickel and its alloys*. Plymouth: Mcdonald and Evans

Child, R. and Townsend, J. (eds) (1998) *Modern Metals in Museums*. Institute of Archaeology Publications

Morgan, S.W.K (1985) *Zinc and its alloys and compounds*. Chichester: Ellis Horwood Ltd

Parr, J. G. (1965) *An introduction to stainless steel*. London: Chapman & Hall

Richardson, J. B. (1974) *Metal mining*. London: Allen Lane

West, E.G. (1982) *Copper and its alloys.* Chichester: Ellis Horwood Ltd

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Objects supplied by: Beamish North of England Open Air Museum.

For further information on SHCG and its activities, see
**www.shcg.org.uk**

Social History Curators Group

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