

The High Possil Meteorite

Extra Information for Visitors

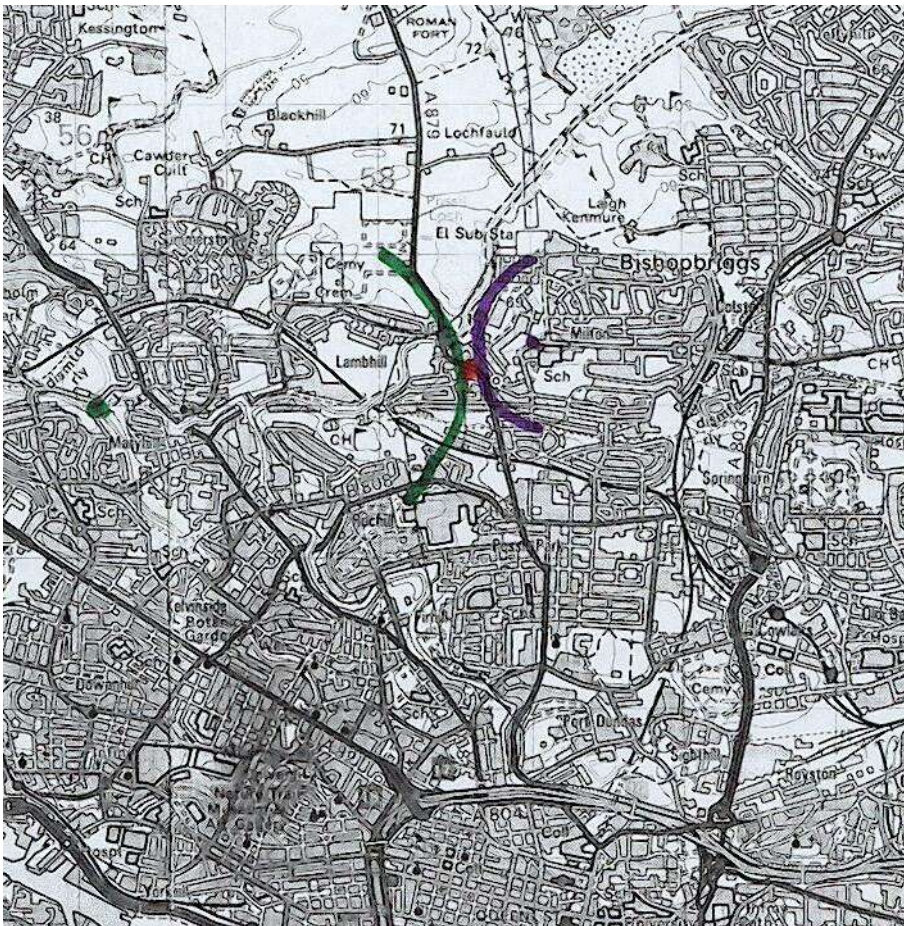
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1. Where did it land?

It is quite difficult to say exactly where it fell. In 1804 there were no good maps of the area, and it has changed enormously since then.

We do know it fell within 90 yards of a big quarry, that it was within $\frac{1}{4}$ mile of High Possil village, and that it was $1\frac{1}{2}$ miles east of where the Forth-Clyde canal crosses the Kelvin. This makes it almost certain that it fell near, or just east of the modern Balmore Road, just south of the canal, in what is now Lambhill. There used to be large sandstone quarries here, long since filled in.



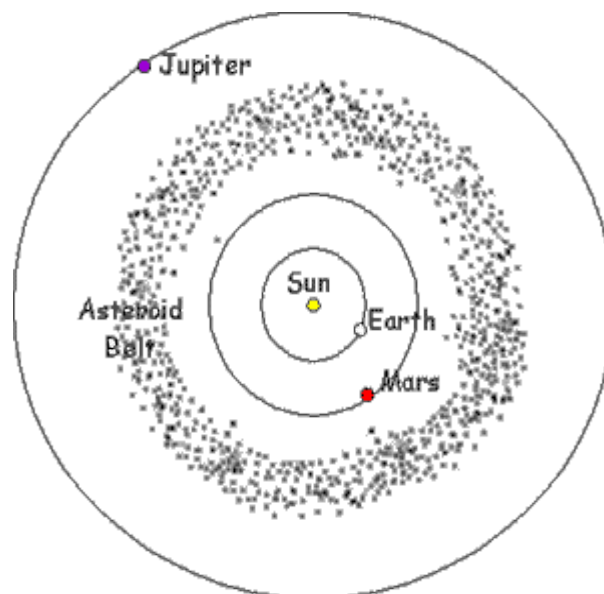
2. Where did it come from?

Most meteorites, including High Possil, come from the asteroid belt, between Mars and Jupiter. This is a zone where small fragments left over from the formation of the Solar System, orbit around the Sun.

Elsewhere in the Solar System, such fragments were "hoovered up" by the strong gravity of larger planets. Indeed, this is how the planets, and the Sun itself, grew in the first place.

Occasionally, asteroid material is dislodged from the asteroid belt, and may crash into other planets: these are what we call meteorites.

A few rare meteorites don't come from the asteroid belt. The "achondrites" are fragments of planets such as the Moon, or Mars. These are texturally and mineralogically quite different to normal meteorites, and much younger in age. The achondrites were probably dislodged from their parent planets by large meteorite impacts, powerful enough to send debris out into space.

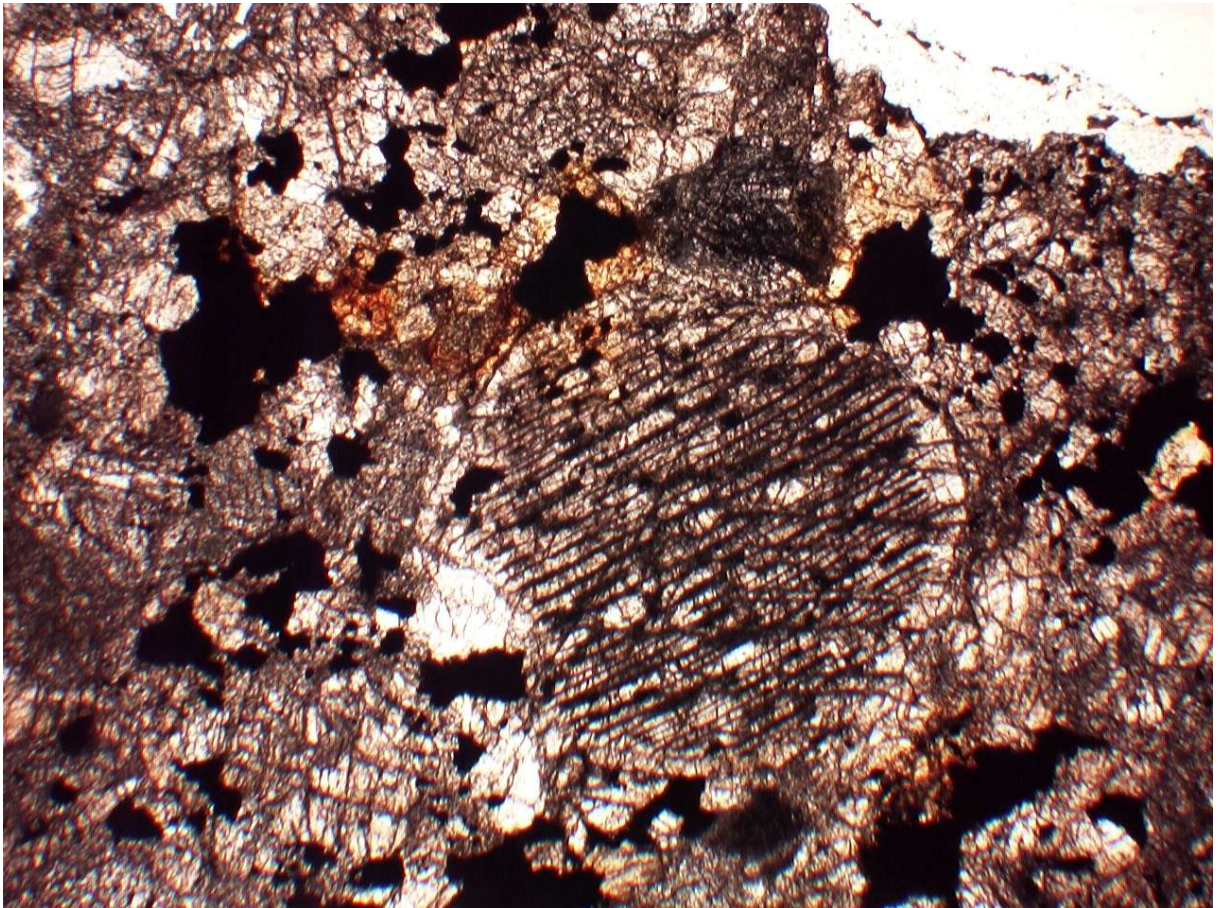


3. What is it made of?

The fresh rock of the meteorite is pale grey. If you look closely at the grey rock, you can see it is made of different minerals: some darker, and some lighter. These are mostly minerals common on Earth: pyroxene, olivine and plagioclase feldspar. The volcanic rock basalt is made of similar minerals.

However under the microscope, the meteorite shows unique textures because of the way it formed in space, and also contains minerals like nickel-iron alloy, and troilite, which are very rare on Earth, so it's easy to tell that it is a genuine meteorite. It's technical classification is an "L6 olivine-hypersthene chondrite". These are quite a common class of meteorites.

The image below shows a polarising microscope view of the slice of the meteorite. The round object is a "chondrule" formed in the first few million years of our Solar System and unaltered since then. The other grains are broken crystals of olivine and pyroxene, and opaque metallic iron which appears black.



4. What is the black crust?

Most meteorites have a black crust after they land on Earth, caused by the outside melting as they zoom through the atmosphere at high speed.

Space craft returning to Earth have the same problem, and have heat shields to stop the heat getting to astronauts or equipment inside.

Similarly, the black crust protects the inside of the meteorite – most small ones like High Possil are cool or warm when picked up just after falling.

5. How fast was it going?

Meteorites can be going very fast in space – up to 150,000 miles per hour, or 50 times faster than the fastest bullets. At this speed, hitting the Earth's atmosphere is like doing a belly-flop into a swimming pool – many meteorites break up as soon as they splat into the upper atmosphere.

The atmosphere slows meteorites down a lot: once they reach the ground, small meteorites can be going quite slowly: just like a normal rock dropped from a height – maybe a few hundred mph.

6. How big was it?

This is the largest surviving fragment of the High Possil meteorite. It weighs 151g. Other smaller fragments are in the Natural History Museum, London, and in Calcutta, Cambridge, and Vienna, among other places.

We know from the eyewitness accounts that the meteorite was about the size of a half-brick when found, but was broken into several parts by the fall, and subsequent activities of quarrymen. The biggest part was thrown away, and was never recovered. It's probably still there, in the now filled-in quarry.

The noises of the meteorite fall were heard over a big area, from Falkirk to Glasgow, and it is very likely that there were other fragments which fell unseen over central Scotland. These are probably still out there, but would be hard to recognise now – meteorites go rusty and disintegrate quite quickly in damp climates on Earth.

7. How old is it?

We can measure the age of meteorites, like any other rock, by radioactive dating. Meteorites like High Possil are among the oldest known objects: about 4500 million years old. They are small bits of debris left over from the events which formed the Sun, and the planets.

Most of these fragments are trapped in the asteroid belt, between Mars and Jupiter, but sometimes one gets knocked out of orbit and crashes into a planet as a meteorite.

Planets like Earth are busy places, and the rocks we see are constantly being created and destroyed by geological processes. Only the small cold meteorites and asteroids in space have remained unchanged. They are our only source of information about the early Solar System.

8. Why is it called the High Possil meteorite?

Since 1847, the Natural History Museum in London has maintained a catalogue of all known meteorites anywhere.

Part of the process of recording involves giving each meteorite, or fall a standard name, so that all scientists working on bits of it know that they are dealing with the same material.

The High Possil meteorite is named after the old village of High Possil, which doesn't appear on many modern maps, but was where Milton school is now. This is a bit to the north of the modern district of Possil, but south of Possil Loch.

Once named, meteorites don't change their names, so it will always be called the High Possil meteorite.

9. Modern Science and High Possil

In 1985, a modern scientific study of High Possil, and another Scottish meteorite, Stathmore, was carried out by scientists from the the Hunterian, the Geology Department at Glasgow University, and the Natural History Museum in London.

A special microscope slide of the rock was cut, with a polished surface. Using a special instrument called an electron microprobe, tiny grains in this slide were chemically analysed.

The chemical composition of the grains, and the textures they display, allowed the meteorite to be properly classified for the first time: it is known as an "olivine hypersthene chondrite (L6)".

It contains some additional rare minerals including native copper (unusual in meteorites, but common on earth) and a calcium magnesium phosphate called whitlockite.

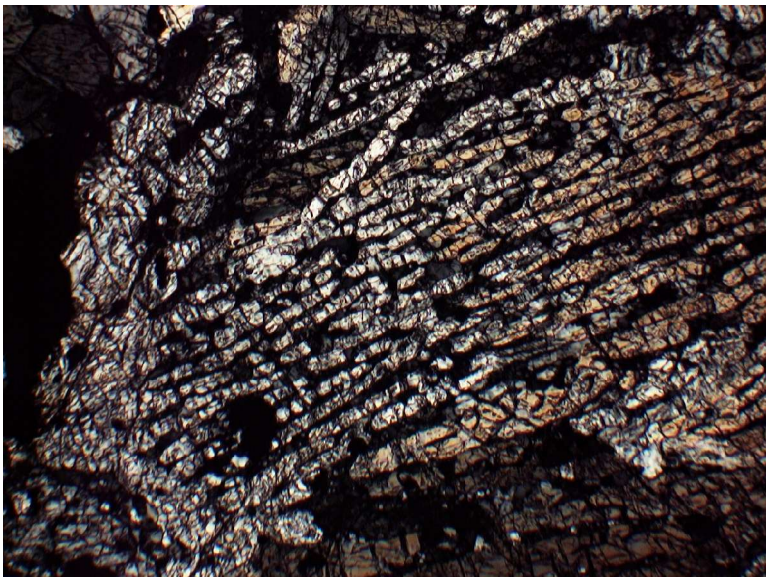
As a witnessed fall, collected very soon after landing, High Possil remains a meteorite of considerable potential interest. Because they are unweathered, such meteorites are especially valuable for investigating the processes which formed them in space.

10. How do we study meteorites?

Meteorites are rocks from space, and the same techniques that geologists use to investigate Earth rocks are used to investigate meteorites.

One of the basic techniques is to saw a thin slice off the rock with a diamond saw, stick it to a glass slide, and grind it so thin that light can pass through. You can see such a cut on one side of the meteorite here.

This allows all the mineral ingredients to be identified, as well as to examine the history of the rock. The slide has been finely polished on the top surface as well, so that individual grains less than 1/100th of a millimetre across can be chemically analysed using an electron microprobe. This slide also shows the dark, but shiny grains of iron metal, as well as the clearer grains of other minerals.



The picture above shows a photomicrograph of an olivine chondrule in the High Possil meteorite. This olivine has been chemically analysed by electron probe without damaging the section.

As well as examining slides like this, mineral grains can be extracted or separated from the rock and analysed using different techniques, which might require the grains to be dissolved or vaporised.

11. How common are meteorites?

Meteorites are quite common: about 100 tons of meteorite debris fall to Earth each day. However, almost all of this is invisibly small dust. It is estimated that a few thousand golf-ball-sized or bigger meteorites do fall every year, but most fall unseen in the sea, or in remote areas. Around 25 are recovered each year across the world.

Many ancient meteorites are found in dry sandy deserts, where the rocky meteorites are preserved in the dry sand, and easily spotted. In the last 30 years huge numbers of old meteorites have been found in Antarctica, where they are easy to find, embedded in the pale ice. Even in deserts, or the cold ice, such meteorites are usually more altered than freshly-fallen ones.

The last recorded fall in Scotland was in 1917. We are probably overdue another one. Let's hope it's not too big, that somebody sees where it lands, and that it doesn't hit anybody!

12. Other Scottish meteorites

Three other meteorites have been found in Scotland since the High Possil fall in 1804.

The Perth Meteorite fell in 1830, but very little was recovered, and now only 2 grams are known to survive.

The Strathmore Meteorite fell in 1917. It broke into four fragments (Easter Essendy (22.25lb), Carsie (2lb 6oz), and Keithick(2.5lb), and one in Forfarshire at South Corston (2lb 5oz)) In total 13.3 kg was recovered. One piece – the Keithick fragment - went through the roof of a house!

In 1998 a meteorite collector found a few small fragments (14 grams) of an old rusty and weathered meteorite in a field near Glenrothes. It is not known when this fell. This the only Scottish meteorite not found as the result of a witnessed fall. There are certainly many more, but Scotland is a big, empty, vegetated country with a wet climate: about the worst possible place to preserve and find old meteorites!

When will the next one be found?

13. METEORITE CLASSIFICATION

There are three main classes of meteorites:

1. STONES	2. STONY IRONS	3. IRONS
<p>Dominated by silicate minerals (like most rocks on Earth)</p> <p>Chondrites</p> <p>Have unique round "chondrules" formed by rapid cooling of molten rock droplets in space. VERY old: > 4400 million years. Some are oldest known objects at 4560 million years: this gives the date of the formation of the Solar System.</p> <p>Most of these are in the asteroid belt, between Mars and Jupiter.</p> <p>Achondrites</p> <p>More like igneous rocks on Earth, Moon, or Mars. Rare. Much younger than chondrites. Debris knocked off planets by late meteorite impacts.</p>	<p>Containing a mixture of iron and iron-nickel alloys, and silicate minerals.</p> <p>Pallasites</p> <p>Crystals of green olivine set in iron-rich metal.</p> <p>Represent the outer cores of early small planets in the Solar System which were shattered and broken up.</p> <p>Mesosiderites</p> <p>Mixtures of fragmented metal, and rock fragments. Probably the outer parts of early small planets and asteroids in the Solar System which were shattered and broken up.</p>	<p>Mostly made of metal, esp. iron and iron-nickel alloys.</p> <p>Several groups distinguished chemically and texturally.</p> <p>Each group may represent the fragments of the core of a separate early planet destroyed in the first few tens of millions of years of the Solar System.</p>

Where to get meteorite information...

A downloadable version of the "Extra Notes for Visitors" is available at:

<http://www.hmag.gla.ac.uk/John/huntmin/hpossnotes.pdf>

The book "Meteorites" published by the Natural History Museum is an excellent introduction to the science of meteorites. Available soon in the Hunterian shop – price £7.95.

Some suggested Web links

1. <http://www.hmag.gla.ac.uk/john/huntmin/hposs.htm>

Information about the High Possil meteorite.

2. <http://www.nhm.ac.uk/mineralogy/intro/project4/index.htm>

An introduction to meteorites from the Natural History Museum in London, one of the world's centres of meteorite research. Their site includes the authoritative list of confirmed meteorite finds:

<http://internet.nhm.ac.uk/cgi-bin/earth/metcat/>

3. <http://www.meteorite.fr/en/basics/>

§Meteorite.fr are a commercial meteorite company, but their pages have lots of useful information. The pages above are excellent on the history of meteorites and how mankind has thought about them. They also have a good page on meteorite classification at:

<http://www.meteorite.fr/en/classification/>

4. <http://www.meteoriticalsociety.org/> The Meteoritical Society

If you follow their Resources, and then Education links, you'll find a very interesting additional set of meteorite and space links.

5. <http://www.barringercrater.com/> The most famous meteorite crater on Earth?

6. <http://www.channel4.com/history/microsites/E/ends/meteorite1.html>

The strange story of the quest for a giant meteorite in the Sahara, plus general meteorite facts.