

In the Footsteps of **Joseph Black**

The discovery of **CO₂**



General Assembly & Technical Meeting
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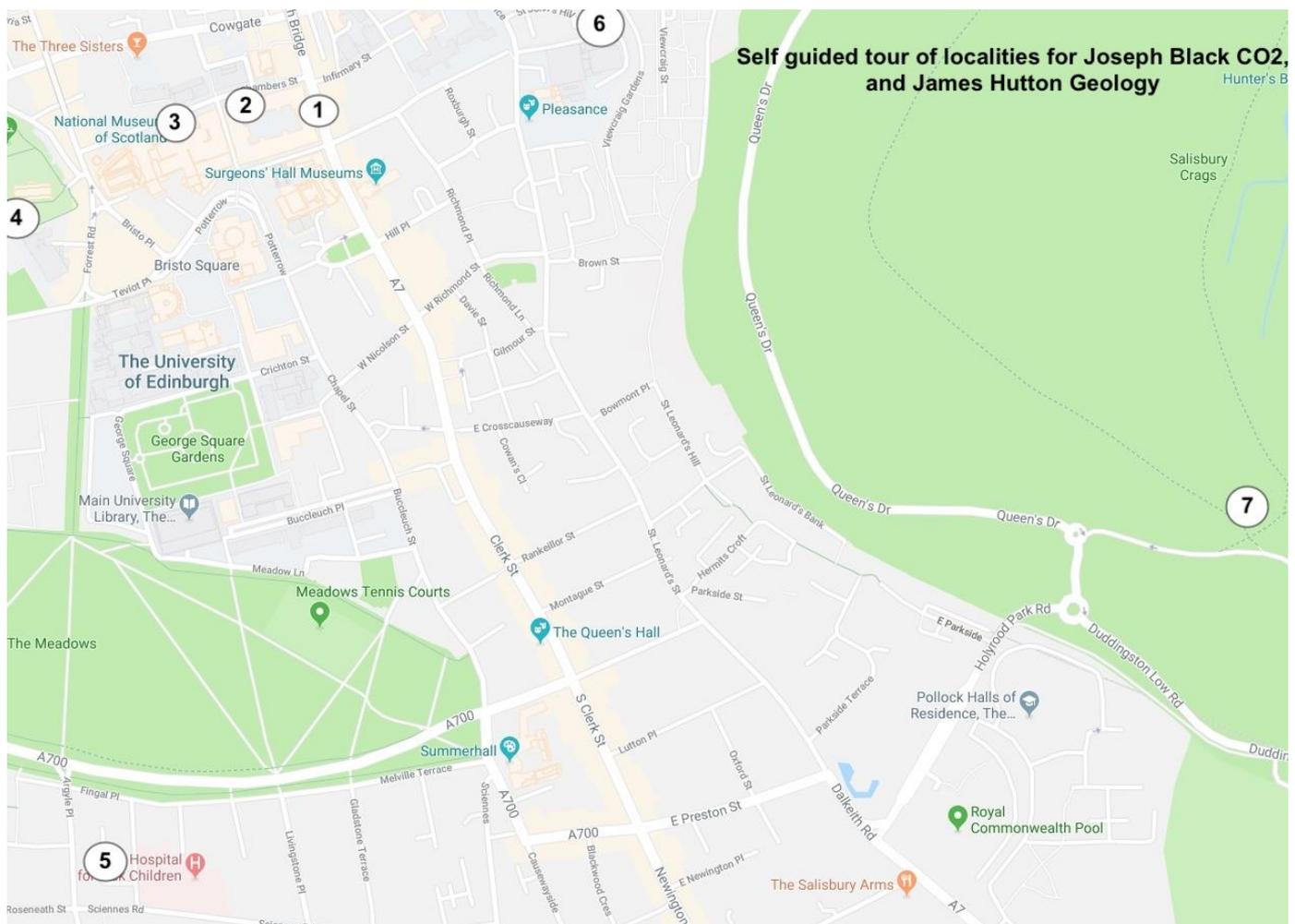
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THE UNIVERSITY of EDINBURGH
School of GeoSciences

Welcome to your excursion guide!

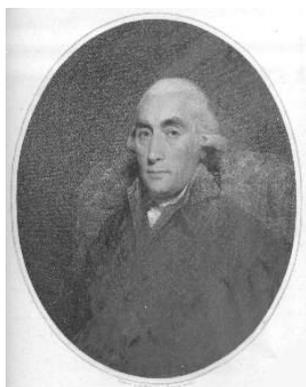
Thank you for joining us on this walking field trip to see the places where Carbon Dioxide (CO₂) was first discovered and named in the world. The short tour will take about one hour. With the optional extension taking an additional hour. We start off with an outside view of Professor Joseph Black's actual laboratory at Old College right here in Edinburgh. Then to visit the National Museum of Scotland, to see some actual laboratory glassware used by Black to make CO₂. And then to Greyfriars churchyard, to see the graves of both Joseph Black, and scientific revolutionary James Hutton, the father of modern geology. Those who wish can go further to Hutton's geological memorial on the site of his former Edinburgh home. And from there a longer walk or taxi to Holyrood Park, where the exact rock formations which informed Hutton about geological time can be encountered face-to-face simply and safely.



1 & 2. OLD COLLEGE, The UNIVERSITY OF EDINBURGH

Meet at the eastern gateway to Old College, opening onto South Bridge, opposite Blackwell's Bookshop. This is the original centre of the University of Edinburgh, constructed on the site where the University was founded in 1583. The architect was Robert Adam, and this is one of Edinburgh most important buildings. Construction started in 1789, but was not completed until 1827, and the dome was added in 1887, with the golden boy representing Youth, with the torch of Learning. Old College originally housed many teaching rooms and laboratories but is now the administrative centre of the University and hosts its Talbot-Rice art gallery. (2) Standing on the southern (left) side of the quadrangle, the windows on the upper left of the opposite facade are the exterior of the former chemistry laboratories. The eminent Enlightenment

chemist Professor Joseph Black (1728–1799) worked and taught at the Universities of Glasgow and Edinburgh. He pioneered quantitative chemical experiments and discovered carbon dioxide. He noticed that when he heated the mineral calcium carbonate, it got lighter. He realised that a gas was being given off and called it 'fixed air' because it had previously been 'fixed' in the rock. In 1755 he read to the Philosophical Society of Edinburgh his classic paper, published in 1756, describing these quantitative chemical experiments many of which had been incorporated in his graduation thesis. Black continued to be an influential teacher and discovered the principles of latent heat and specific heat. During archaeological excavations for a major re-landscaping of the quadrangle in 2010, the remains of old scientific equipment were discovered. The fragments of thermometers, test tubes, storage jars and chemicals found may have once belonged to Joseph Black. It is thought that these are apparatus and chemicals which had been left in storerooms by Black's laboratory when it was demolished in the 1790s.



Joseph Black ©UoE



Old College north-west corner upper floor was Chemistry ©UoE

3. NATIONAL MUSEUM OF SCOTLAND JOSEPH BLACK AND CARBON DIOXIDE



Against the odds, some of Joseph Black's own laboratory equipment has survived. The National Museum of Scotland has a large display glass cabinet in the [Enquire gallery on level 5](#). The equipment displayed comprises laboratory glassware and his measuring balance. These examples were used by Black in his lectures in Edinburgh from the mid-1760s onwards.

The glassware was made locally, from green bottle glass, in glassworks in the port of Leith 3km northeast from the Museum. The glass industry had been founded on the need for wine bottles to hold imported claret (red wine from France). The glassworks owner, Archibald Geddes, had attended Black's lectures in 1778–80. Geddes' glassworks chose to diversify and advertised that it also made scientific glassware. Professor Black subsequently invested in his business. It made articles including glass apparatus for impregnating water with 'fixed air', Black's term for carbon dioxide. This made possible the domestic production of 'spa water', so the apparatus was also commercially successful. The display material was preserved by the University of Edinburgh, until passing to the Museum in 1858.



Level 5 Gallery



Glass vessel with calcium carbonate



pneumatic bellows to collect fixed air

Photos ©NMS

4. JOSEPH BLACK, GRAVEYARD

Greyfriars Kirk

Adjacent to the National Museum in the Greyfriars Churchyard, famous for the more recent story of "Greyfriars Bobby" a small Skye Terrier dog, who allegedly guarded his owners grave for 14 years until he died himself on 14 January 1872. The church and churchyard have been used since the 1500's, and many famous Edinburgh citizens were buried there. Black never married. He died peacefully at his home in Edinburgh in 1799 at the age of 71 and is buried in Greyfriars Kirkyard, in a locked section to the southwest known as the Covenanters Prison. Access can be arranged by inquiry at the visitors desk inside the Kirk.



© Wikipedia

James Hutton, the father of modern geology, is also buried here.

5. JOSEPH BLACK, House at 13 Sylvan Place (Optional)

A short walk southward across the meadows public grass park, takes you to the district of Sciennes. Most of this group of houses are stone tenements of 4 to 6 floors from the 1800's. Remarkably, in the rear gardens of one such street, is a much older two-level house, believed to have been the residence of Joseph Black. Entry is along Sylvan Place, and immediately south of number 12, an un-named road allows access to a white cottage oriented perpendicular to the road, in the older style of village layout. This has a plaque but is privately owned with no visitor access.

And if you want to walk a bit further... discover more of the sites where the immensity of geological time was first invented in Edinburgh, by James Hutton, a Scottish landowner with good observation of rocks

6. JAMES HUTTON MEMORIAL GARDEN (Optional)

This marks the site of James Hutton's Edinburgh home. The garden contains a memorial plaque and five boulders which illustrate two main themes of Hutton's geological work. The three conglomerate boulders are lower Devonian from Dunblane and are full of fragments of even older rocks, demonstrating the continuity and cyclic nature of geological processes. Hutton used the intrusion of granite veins into metamorphosed schist in Glen Tilt near Blair Atholl (derived from sedimentary rock) to demonstrate that molten granite must have been younger than rocks it penetrated. Absolute dating was not achieved until Arthur Holmes applied radioactive isotope decay to minerals in 1913



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WHY IS HUTTON FAMOUS?

James Hutton is credited with the invention of 'deep time', i.e. the concept that the Earth is extremely old, and not a few thousand years as suggested by a literal interpretation of the Christian Bible which calculated the earth to form at 9 AM on October 26, 4004 BC. Long geological time is needed not only to allow for the processes recorded in the geological record, but also crucially for evolution of life to occur – which informed Darwin's timescales.

7. HUTTON'S SECTION IN HOLYROOD PARK (Optional)



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A key site in Hutton's new understanding of geology is at the south end of the Salisbury Crags escarpment formed by the intrusive dolerite sill that is over 300 million years old. Hutton associated 'extreme heat' as the agent of folding and uplift of strata. The question as to what produced the heat could not be answered at that time. In Hutton's own words "We know that the land is raised by a power which has for its principle subterraneous heat, but how that land is preserved in its elevated station, is a subject which we have not even the means to form a conjecture."

Hutton postulated "Uniformitarianism" – processes today are similar to those of the past. He believed that molten rock (magma) under pressure could be 'intruded' between or across

layers of sedimentary rocks, sometimes reaching the surface as lava flows. He found evidence to support this in Holyrood Park. The photograph shows a section of the Salisbury Crags sill where igneous rock (called whinstone locally) has been intruded between sedimentary layers. Here, at the base of the sill, magma has forced its way into the underlying sedimentary strata. This shows the sill to be moving and younger than the sediments, in contrast to the Bible belief of Noah's Flood.

ACKNOWLEDGEMENTS

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This guide was last updated 10 November 2022 with changes to item 3 (National Museum of Scotland), for the purposes of the LAUNCH General Assembly & Technical Meeting. Richard Lo Bianco & Richard L Stevenson, SCCS.